Universitat Autònoma de Barcelona

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A sociophonetic analysis of the production of mid-vowel contrasts in Catalan spoken in Barcelona

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Contents

Abstract

The present research deals with language variation and presumably change from the theoretical perspective of apparent-time studies. It aims to explore the retainment or merging of the Catalan mid-front and mid-back vowel contrasts, and whether merging is complete or yields a near-merging scenario, based on the production of mid-vowels by bilinguals with a stronger command of Catalan (Catalan-dominant) as well as by bilinguals with a stronger command of Spanish (Spanish-dominant), all residents of Barcelona, Spain. In the dual speech community of Barcelona, members find themselves in a situation of both *territorial* and *societal bilingualism*.[1] The variety of Catalan spoken in Barcelona (Central Catalan) possesses two sets of phonemic mid-vowels (/e/-/ɛ/ and /o/-/ɔ/), unlike Spanish which has a single vowel per set (/e/ and /o/). The impact of the independent variables of gender, age, language dominance and mother tongue on mid-vowel production is assessed, providing insight into the non-linear nature of language variation and change.

Seventy-two Catalan/Spanish bilingual residents of Barcelona of different generations (their ages range from 15 to 75) were recorded reading aloud a Catalan passage including the following stressed vowel instances, /e/, /ɛ/, /o/ and /ɔ/, which were subjected to an acoustic analysis alongside the /i/, /a/, /u/. F1 and F2 values of all seven vowels that are implicated in the data were submitted to a speaker normalisation procedure. A method was applied for determining whether F1 frequency differences between close-mid and open-mid vowels corresponded to a vowel contrast or (near-) merging scenario. The effect of gender, age, language dominance and mother tongue on the mid-vowel differentiation was analysed statistically. As regards the two latter variables, subject grouping on the basis of language dominance is determined by the results provided by the Bilingual Language Profile (BLP) questionnaire (Birdsong, Gertken and Amengual 2012), an instrument for assessing language dominance through self-reports; subject grouping according to the mother

[1] *Territorial bilingualism* lies in the fact that two (or more) languages have official status in a politically defined territory. According to Hamers and Blanc (1989), *societal bilingualism* includes the notion of *bilinguality* or *individual bilingualism* and refers equally to the state of a linguistic community in which two languages are in contact with the result that two codes can be used in the same interaction and that a number of individuals are bilingual. Hamers (1981) has formerly introduced the concept of *bilinguality* or *individual* bilingualism, which refers to 'the psychological state of an individual who has access to more than one linguistic code as a means of social communication; the degree of access will vary along a number of dimensions which are psychological, cognitive, psycholinguistic, social psychological, social, sociological, sociolinguistic, sociocultural and linguistic'.

tongue factor relies on a count of the acquisition of Catalan or Spanish as either first or second language.

A number of conclusions based on the statistical analyses performed and dataset trends are drawn. It was first found that Catalan bilinguals achieved a better mid-vowel distinction than Spanish bilinguals. Overall, mid-front vowels were better differentiated than mid-back vowels at a production level. It was also found that older speakers tended to better retain the mid-back vowel contrast. Youngsters and young Spanish speakers, whose parents are both Spanish, performed better than middle-aged and older Spanish speakers. The results further demonstrated that Catalan female bilinguals tended to have a more robust mid-vowel differentiation than Catalan male and Spanish female bilinguals. Implications which suggest that variation is involved in this study are discussed and potential explanations are offered.

Chapter 1

1. Introduction

During most of the second half of the twentieth century, individuals in Catalonia were raised in and lived under prolonged and stable bilingualism. In the aftermath of Franco's long-lasting dictatorship (1939-1975), the establishment of a language law, the Language Normalisation Act of 1983,[2] propelled Catalans further into the development of language education policies in a way that would preserve and promote the Catalan language through compulsory education in Catalan. Before 1978,[3] Catalan had no official status, consequently it could not be incorporated into the educational system of Catalonia. However, the current legal status of Catalan and Spanish in society, public administration and education, establishes the learning, use and diffusion of both languages in the Autonomous Community of Catalonia, which remains part of Spain's sovereign state. In light of Catalans' linguistic duality, this study investigates the production of the Catalan stressed mid-vowel contrasts /e/-/ɛ/ and /o/-/ɔ/ in the speech of Catalan and Spanish-dominant individuals as well as in the speech of individuals whose parents are both Catalan and Spanish.

The present thesis goes beyond the scope of detecting a deficit in speech production attributed to speakers of the Spanish-dominant group who have been born, raised and educated in Barcelona. It aims to provide a twofold consideration of phonological variation and language change issues in Barcelona's bilingual community. From a sociolinguistic perspective, findings drawn from interviews will have implications for both assessing bilinguals whose language dominance (LD) is Catalan or Spanish and bilinguals whose first language (L1) is Catalan and second language (L2) Spanish, or vice-versa. From a sociophonetic viewpoint, this project will explore the maintenance or merging of the mid-front and mid-back vowel contrasts and whether merging is complete or yields a near-merging scenario.

[2] In 1983, the Language Normalisation Act was passed, a law of great importance in education and mass media. This linguistic policy was set up with the aim of standing up for the right of children to receive their primary education in Catalan. The full text of the Language Normalisation Act (LNA) can be found entitled: *Llei de Normalització Lingüística a Catalunya*, (*DOG* núm.322, de 22 d'abril de 1983), 14 (1), (2).

[3] Article 3, provision 2 of the Spanish Constitution of the 1978 explicitly states that 'the rest of the Spanish languages will also be official in the respective Autonomous Communities in accordance with their Statutes', (see section on-line sources for details).

This introductory part will set the stage for the thesis. Catalan-speaking bilingual people interact through speech with Spanish-speaking bilingual people of different gender and age on a daily basis. Given this language contact situation, 1.1 of the Introduction will be devoted to language contact. In section 1.1.1, our attention will be drawn on the language contact phenomena of *borrowing*, *transcodic markers*, *interferences*, *code-switching* and their mechanisms.

Sections 1.1.2 and 1.1.3 will be devoted to the contact-induced changes which take place in districts of the city of Barcelona and on the island of Majorca, respectively. Revisiting current literature, especially of such similar works previously done, is fundamental for developing research in the field of language variation and language contact situations. An approach of interactive differences between females and males, among different age groups, between the L1 and L2 and between dominant and non-dominant languages will be critical as all these factors have a great deal in common with language variation and contact-induced changes. Lleó et al. (2008) have already explored the realisation of the mid-open vowels and the mid-central schwa by taking two population samples of Barcelona, one of the district of *Gràcia* and one of the district of *Nou Barris*. In the aforementioned study, each population sample is determined by different generation groups and is different from the other concerning the maintenance or loss of /ɛ/, /ɔ/ and /ə/. The study conducted by Lleó et al. will help this project to expand the scope of the investigation beyond a single sociolinguistic variable (age) into exploring the contribution of gender, age, language dominance and mother tongue to language use.

Section 1.1.3 of this chapter will consider recent work done in the field, in the bilingual speech community of Majorca. Amengual (2011) has examined the impact of language dominance on the production of the Catalan mid-vowels produced by two dominant groups (Catalan, Spanish), residents of Majorca. Similarly, Amengual´s research work will contribute useful information to indicate new findings in the context of contact within the speech community of Barcelona. An aspect of language contact and native-like attainment of the L2 research has been described in Simonet (2011). In his investigation, a focus on cross-language interactions emphasised the difficulties in mid-back vowel production by exploring the within-subject patterns and interactive differences between the two vowel subsystems developed by early Spanish/Catalan bilinguals. Simonet's work on the Catalan mid-back vowel contrast has shed light on the orientation of

contact-induced changes. Despite my research project addresses the issue of contact influence from Spanish to Catalan, it may be helpful to consider that language contact influence goes further as Catalan has an impact on the vowel phonetic distribution of Spanish.

In section 1.2, the notion of language variation will be treated, aiming to reveal the extent of internally generated variability in the vowel inventory of Catalan, which is also shaped by the impact of social factors on speakers' linguistic performance. Section 1.2.1 will treat changes from within (mergers) which vowels of the Catalan system are likely to be subjected to. A set of examples of mid-vowel mergers and near-mergers will be provided in section 1.2.2, as being in line with variability and dispersion effects on mid-vowel production.

Section 1.3 will provide the reader with information on the two major clusters of dialects of the Catalan language (Eastern, Western). In doing so, special attention will be paid on Eastern Catalan, which includes the Central Catalan variety spoken in Barcelona. A fairly detailed description of patterns across Central Catalan will be presented, followed by a description and comparison of the vowel inventories between Central Catalan and Spanish. An overall distribution of vowels in Central Catalan will be thus determined because the four stressed mid-vowels, which are the focal point of this study, form part of the vowel system of this variety.

Section 1.4 will provide, among other definitions, an overview of the concept of language acquisition, which consists of a complex notion used to depict the degree of bilingualism manifested by individuals. It has been deemed necessary to treat language acquisition as the last theoretical issue viewed from the perspective of bilingual acquisition. Thus, this section will give valuable insight into the concepts of first-language acquisition (L1) and second-language acquisition (L2). Language acquisition (L1), also considered to be mother tongue, will be fully elaborated in section 1.4, that will also intend for gaining an insight into the sociolinguistic variables of gender, age, language dominance and mother tongue in order that later, if required, fined-grained differences within the dataset could be interpreted as effects of social factors.

Section 1.5 will include the hypotheses to be tested in the present study. Finally, section 1.6 will provide the chapter by chapter thesis plan.

1.1 Language contact

Language contact has become the subject of academic interest for many decades. In fact, language contact is a widespread phenomenon across bilingual or multilingual communities. The literature is departing from field researches done in natural settings where the speech community is entirely monolingual (Labov 1966; Trudgill 1974; Milroy 1980) and moving toward works on dialectal configuration of a majority language spoken by natives in a bilingual community (see Blas Arroyo 2011, for a review of Spanish in contact with Catalan). In the present study, I deal with a language contact situation in which members of a bilingual speech community interact through speech among themselves using any of the two languages (Catalan or Spanish) that are present.

1.1.1 Language contact phenomena and their mechanisms

From a variationist viewpoint, the stressed mid-vowels that will be discussed in the current study may exhibit *inherent* as well as *external* variation. *External* variation is not conceived as directly relevant to the Catalan vowel inventory; it is determined by extra-linguistic contexts, such as the degree of influence Spanish exerts on Catalan. By way of contrast, *inherent* variation refers to internally generated variability that happens when the vowel inventory size and quality characteristics alone are responsible for the maintenance or loss of an audible difference between vowels.

In this section I will concentrate on language contact phenomena which are at the centre of work over the last half-century. While there is a wide number of different language contact situations in the literature (see Bowern 2013: 342), the current situation in Catalonia exhibits strong lexical, morphosyntactic and phonetic effects of language contact. Note that any of the two languages, which is used systematically in the community in question, is genetically related even if quite a lot of the Catalan and Spanish words derive from two different Latin sources, such as Catalan *taula* 'table' (from Lat. *tabula*) versus Spanish *mesa* 'table' (from Lat. *mensa*). Phonetic effects on Catalan from Spanish are triggered by *borrowing*. The term involving the transference of features from an A linguistic system to a B, merits particular attention in my discussion. Before doing so, it is worth mentioning the concept Lüdi introduces regarding markers in speech. Lüdi coined the term *transcodic marker* as follows:

Marques transcodiques, c'est-à-dire marques, dans le discours, qui renvoient d'une manière ou d'autre à la rencontre de deux ou plusieurs systèmes linguistiques (calques, emprunts, transferts lexicaux, alternances codiques etc.) (Lüdi 1987: 2).

Transcodic markers are thus concerned with language contact phenomena, such as *interferences* and *code-switching*, that can occur at all levels of the linguistic system, e.g. in semantics, lexicon, morphosyntax and phonology. The concept of *interferences* has long been a key tool for understanding the relationship between a speaker's native language (L1) and his/her second language (L2) in bilingual settings. The most commonly considered cases involving interferences are these, in which the influence L1 exerts on L2 can easily be identified. Badia's example (1973) may serve to illustrate what interferences look like on the ground. Nominal groups including the [z] of ligature may be pronounced erroneously in Catalan, in cases where, like in Spanish, the [z] of the nominal group in question is realised with an [s]. Consider the following Catalan example with a 'Spanish like' pronunciation:

> *Els homes*, [əls ɔməs] 'men' pronounced with an [s] exhibits a voiceless fricative instead of the [əlz ɔməs] realisation which shows a voiced fricative.

Manifestations of phonological interferences are interpreted in a narrow sense. This means that transfers for Catalan-dominant individuals take place from their L2 (Spanish) to their L1 (Catalan), while for Spanish-dominant individuals come to light form their L2 (Catalan) to their L1 (Spanish). Furthermore, the top-down relationship of interferences, from a socially dominant to a socially subordinate language, with Catalan being most probably in this research context the dominant language of the social setting, can be reversed over time particularly in areas like Barcelona where the social context favours the use of both Catalan and Spanish.

Clearly, when it comes to defining what *code-switching* involves, authors use to recur to considerations of *speech accommodation* that may lead to switching in speech between two different languages. By its very nature, *speech accommodation* requires convergence in the sense that a bilingual speaker chooses to use for a conversational turn one of the two language varieties

he/she speaks. Switching from one language to another within the same discourse, most regularly takes place in an attempt to achieve communicative efficiency.

Mysken (2000) with expansions in Mysken (2013),[4] has argued that *code-switching* is not a unified phenomenon. Different types of *code-switching* have been observed so far and depend on the languages involved as well as the nature of the speech communities. Gumperz and Hernández-Chavez (1975: 158) have stated that *code-switching* can take a specific shape in discourse; it may range from describing the switch at a single word to a whole sentence. Despite one might applaud the concept of *code-switching* from such a sociolinguistic perspective, what should not be neglected is whether the process entails the alternate use of lexical items or complete sentences. My own views are that the introduction into language A of specific lexical or morphological items, which derive from language B, describes quite accurately the phenomenon of *borrowing*. Sociolinguistics is well positioned to show different theories on *borrowing* and *code-switching* which have been established by scholars who refer to noticeably different language contact processes. A number of definitions of these processes will therefore be provided below.

I shall now outline three different types of *code-switching*: *tag-switching*, *intersentential* and *intrasentential code-switching*, all three provided by Poplack (1980). A distinction between *tag-switching* and *code-switching* was allegedly first made by the same author. Poplack points out that '*tag-switching* involves the insertion of a tag in one language into an utterance which is otherwise entirely in the other language'. The insertion of *vale* ('OK') Spanish interjection is presented systematically in the conversation of Catalan-speaking bilinguals as it fits grammatically with the rest of the sentence. Here is an example we can think of: *'¡Vale! Quedem per veure'ns demà*'. It would be fair to say that owing to the long-term language contact situation, Catalan speakers use occasionally the Spanish tag *vale* in their discourse even when they express themselves in Catalan. Tag-switching appears to overlap to some extent with what Grosjean calls 'unconscious interference'. Grosjean (1984: 299) argues that the individual bilingual circumvents *code-switching*, which may impede communication, but cannot avoid interferences of such kind.

[4] A trifold strategy has been developped by Mysken (2000, 2013) to deal with different stages of code-switching (insertion, alternation and congruent lexicalization) in bilingual speech communities.

Romaine (1989) following Poplack (1980), provides a set of definitions for *code-switching* as the latter scholar precisely distinguishes between *intersentential* and *intrasentential code-switching*:

Intersentential switching involves a switch at a clause or sentence boundary, where each clause or sentence is in one language or another.
Intrasentential switching involves instances where a switch or mixing of languages occurs within the boundaries of a clause or sentence.

Regarding *intersentential switching*, I shall now reproduce a good example from Puerto Rican bilingual Spanish/English speech given by Poplack (1980): 'Sometimes I'll start a sentence in English *y termino en castellano*'. The distinction between intrasentential code-switching and borrowing, however, is not always clear. Many scholars have claimed that there is confusion over the terminology often posited to explain a consistent division between the alternate use of two languages and the introduction of lexical items of language A into language B, both within the same discourse.

According to Winford (2013: 175), borrowing poses limits to what can be transferred from one language into another and under what conditions. In this regard, *lexical borrowing* is considered to be the most readily apparent language contact effect as transfers of structural elements, both phonological and morphological, are subsequent to lexical borrowings. When we give some thought to the Spanish word *vale* as a purely grammatical category, we notice that *vale* emerges in Catalan as a result of lexical borrowing from Spanish. On the morphological and phonological level, it appears to introduce no new phonemes, thus, new phonological elements do not necessarily go hand in hand with lexical transfer. Yet, the *vale* lexical borrowing example seems to corroborate what Appel and Muysken (1987: 153) argue about lexical entries and structural elements: 'the meaning and the phonetic form of a word are not necessarily always borrowed together'. Haugen (1950: 212), who delimits borrowing from other language contact phenomena, describes it as 'the attempted reproduction in one language of patterns previously found in another'.

Haugen's adoption of the idea about borrowing offers a framework within which to investigate the mechanisms of *importation* and *substitution* (both terms can be found in Haugen 1950). The mechanism of *importation* gives rise to borrowings, which come into play as part of the integration of loan words from the *source language* into the recipient language.[5] On the other hand, the mechanism of *substitution* which gives rise to *calques*, should be viewed as a process which does not fully allow the integration of new lexical entries into the morphological structure of the *recipient language*. The term *calque* has been established under the need to describe words, which have been formed by translation of a corresponding word in a source language. In dealing with the linguistic phenomenon of *calques*, Blas Arroyo (2013) indicates a demonstrable case of literal translation from Catalan to Spanish (*a más a más*, Std. Span. *además* ['moreover']) fairly attributable to language contact between the two languages. It is important to mention that the process of linguistic integration takes place inversely, no matter which of the two languages involved (Catalan, Spanish) is the source language. For instance, Catalan has acquired Spanish forms like *tenir que* (Std. Span. *tener que* ['have to']) via lexical borrowing from Spanish which would be integrated to such an extent that would conform in the future to the morpho-phonological and grammatical rules of Catalan. In the case of *tenir que* + infinitive, the process involves the adoption of a verbal periphrasis from Spanish, which has no counterpart in the recipient language since the equivalent form to express personal obligation in Catalan goes as follows: *haver de* + infinitive.

The processes of language contact phenomena mentioned above, rest mainly on linguistic dominance relationships among members of the speech community of Barcelona. By and large, language contact inevitably leads to variation within the speech community. To consider language contact as the result of an interaction between two different languages, which may well impact on the way in which a subject answers questions and reads in a certain language due to the influence of another, would take us into the domain of sociolinguistics. However, within the scope of phonetics and phonology, variation lies inherently in the internal structure of a language as different sounds may appear in the same environment without changing the meaning of a word. In the spirit of Labov (1963, 1969), I would like to present evidence in the following section which

[5] The distinction between source language and recipient language was first made by Van Coetsem (1988).

tests the hypothesis that variation, which does not occur haphazardly but with a high degree of systematicity in a given speech community, should be interpretable within quantitative models.

Some of the most eminent examples cited above, explain that pure lexical items transferred from one language to another, seem to be integrated to the morphology, syntax and phonology of the language these items end up. As processes such as borrowing and code-switching also tend to be motivated by implications of language dominance and first language acquisition (Catalan or Spanish), instances of mid-vowel interferences that hinge on both these factors can easily be predicted in the language contact situation of Barcelona. What seems uncontroversial here is that if bilingual speakers' language dominance and L1 is Catalan, utterances from their subordinate language and their L2 (Spanish) will be adapted to their dominant language and L1 (Catalan). Additionally, if bilingual speakers' language dominance and L1 is Spanish, utterances from their subordinate language and their L2 (Catalan) will be adapted to their dominant language and L1 (Spanish). Dealing with borrowing of structural elements, Winford (2013: 175) efficiently highlights that even in situations where significant phonological change has occurred due to language contact, little evidence of direct transfer of phonemes has been documented.

1.1.2 Contact-induced changes in mid-vowel production in Barcelonan Catalan

The importance of a focus on social environment and generation in the production of vowel phonemes is heeded by Lleó, Cortés and Benet (2008), who conducted a careful study on on-going changes in the vowels of the Catalan language spoken in two districts (*Gràcia* and *Nou Barris*) of the city of Barcelona. Their research, involving the criterion of markedness, seeked to identify the impact of internal factors on the Central Catalan variety spoken in Barcelona. These factors will be discussed in the present section. According to the authors, the Catalan vowel system is more marked than the Spanish vowel system as the former shows two degrees of height ([+open] / [+close]) within mid-vowels. Catalan displays low-mid-vowels (/ɛ/ and /ɔ/), which particularly stand out as less usual vowels in comparison to the Spanish high-mid-vowels (/e/ and /o/). It should be noted that, in general, the open-mid-vowels are relatively rare considering languages from all around the world, in the sense that they appear less frequently than the close-mid ones. Moreover, the authors have divided bilingual participants (Catalan and Spanish-speaking individuals) into three generational groups (G1: children between 3 and 5 years old, G2: youngsters between 19 and

23 years old, and G3: parents of the children who belong to G1, whose age is between 32 and 40 years old). This division has been helpful to better understand the effects of social factors on the mid-vowel distinction of the Catalan language.

It is in the context of age that Lleó et al. discuss phonological changes in Catalan. Much of this change in Central Catalan appears to be taking place as a reflection of generational differences. A person who attended school during the years that Franco had established a military dictatorship in Spain would not speak the same Catalan variety as a person who attended school from 1983 onwards, after the teaching of Catalan was implemented through several hours of mandatory classes. A percentage of usage was provided for the production of the mid-central schwa and the mid-open vowels in each generational group. Thus, in the study of Lleó et al. age seems to be the predominant social factor that is thought to influence the realisation of one vowel phoneme over another.

Whether G1 and G2 subjects are residents of *Gràcia* or of *Nou Barris,* was found to be crucial for the production of /e/-/ɛ/, /o/-/ɔ/ and [ə], as the two younger generations leaded to statistically different results, with considerably higher percentages in *Gràcia,* the traditionally Catalan district, than in *Nou Barris*. Lleó et al have provided an overview of the results of their work. The general hypothesis for loss of the schwa and open-mid-vowels in Central Catalan, has been partly confirmed along with full confirmation provided for the expected degree of similarities regarding the way each vowel was produced by G3 across districts. In this regard, their results demonstrated that G3 in both districts (*Gràcia, Nou Barris*) did not show any significant differences in the production of mid-vowels and schwa. In terms of the maintenance of mid-vowels, quite similar mean vowel percentages (72% in *Gràcia* and 67% in *Nou Barris*) were found across those areas. Whilst G3 subjects, residents of *Gràcia* and *Nou Barris* developed some kind of symmetry regarding the production of the Catalan vowels, this is rather a questionable explanation for their children (G1), who showed a significant difference in vowel production across districts. The G1 group, as it has become evident through authors' discussion, had more often two degrees of aperture and schwa in *Gràcia* but a single degree of aperture and no schwa to show in *Nou Barris*. What has been deduced is that, there is little input from parents in children's language development. Children's speech production across districts is apparently much more linked to the

social setting they live in than family. In a similar vein, the G2 percentages of low-mid-vowels and schwa were found to be remarkably lower in *Nou Barris* than in *Gràcia*. Furthermore, it should be stressed that the G2 in *Gràcia* was the group that reached the highest target-like results of total sample for mid-vowels and schwa. Based on what Lleó et al. found, I should argue that a stronger education effect would be expected on the G1 and G2 groups from *Nou Barris*. Their findings seem to indicate that the social setting effect of a Spanish-speaking district has the greatest impact on both these groups. The education effect would be expected to be quite strong for both G1 and G2 groups from *Gràcia* and *Nou Barris*, respectively, as these groups have been schooled in Catalan.

Lleó, Cortés and Benet (2008) investigated vowels' loss in-progress, which was conditioned by both age and social setting. Their experiments undoubtedly demonstrated that social factors such as age within the scope of generational difference among subjects affect the accuracy with which speakers can produce the vowels in question. Although age and social setting can explain why the mid-open Catalan vowels have merged with their mid-close counterparts, this set of factors (generational differences, place in which subjects grew up and live) only provides the general picture of how certain social factors interface with linguistic factors. The investigation of a more complex set of social factors, such as social network and style would be crucial for the study, as all factors work together to influence subjects' accuracy in the production of mid-vowel phonemes and schwa in Central Catalan.

1.1.3 Contact-induced changes in mid-vowel production in Majorcan Catalan

The goals of this section are firstly to get a grasp of the overall field and live issues in the current research. The paper by Lleó et al. (2008) raises, among other discussions, the significant question of whether there is a striking opposition between the mid-front contrastive vowel pair (/e/-/ɛ/) and the mid-back contrastive vowel pair (/o/-/ɔ/) in the variety of Catalan spoken in Barcelona. By reviewing another work previously done relative to the contact-induced changes in Majorcan Catalan, my aim is to identify what the best course forward might be so as a new contribution to knowledge could be made.

Amengual (2011) attaches much weight to what is the role of language dominance in the realisation of the mid-front and mid-back Catalan vowels. The author explores qualitative differences in the context of two sets of data as these are found in the speech of Spanish-speaking and Catalan-speaking dominant bilinguals who reside in the island of Majorca. The first is a cross-linguistic survey of mid-vowels produced by 8 male and female speakers, all aged between 18 and 62 years, whose native languages are either Catalan or Spanish. He divided bilingual speakers into two small language dominance groups (4 Catalan-speaking bilinguals belonging to the Catalan-dominant group and 4 Spanish-speaking bilinguals, respectively to the Spanish-dominant group). Measurements were made upon the F1 and F2 frequency values in order to determine the quality characteristics of the four vowels of the mid-vowel pairs /e/-/ɛ/ and /o/-/ɔ/. Amengual's experiments demonstrated that there is no substantial difference between Spanish dominants' and Catalan dominants' speech production regarding all four mid-vowels. [6]

Amengual seems to suggest that neutralisation does not lie behind the contrastive minimal pairs /e/-/ɛ/ and /o/-/ɔ/. Hence, it can be argued that speakers of both Catalan and Spanish groups display contrastive mid-vowels in Majorcan Catalan. However, a limitation of this research is that the sample size of the study is very small. The number of bilingual speakers (8) and subsequently differences are rather narrow for conclusions of statistical significance to be drawn from the results of the (Catalan/Spanish dominant) population sample.

Beyond the most recent studies mentioned in this section, little sociolinguistic information on the production of Catalan mid-vowels by Catalan/Spanish bilinguals has been adduced in discussions of language contact, however important it may be for gaining an insight into language contact phenomena. A great deal of attention linguists have paid to the influence of language on perception developed by bilinguals in Catalan and Spanish.[7]

[6]Amengual run a Welch Two Sample t-test for contrasting the F1 and F2 frequency values produced by the Spanish-speaking dominant group with those produced by the Catalan-speaking dominant group. The table of the Welch Two Sample t-test can be seen in Amengual 2011: 221.

[7] For a more detailed discussion of perception patterns developed by bilinguals, see Escudero and Boersma (2002), Sebastián-Gallés et al. (2005), Cortés et al. (2009), Mora and Nadeu (2009), Mora and Keidel (2010).

Another recent study that allows us to have an understanding and knowledge of the contact situation in Majorca is Simonet (2011). Simonet presents the study of language contact in terms of the description of the production of the stressed Catalan /o/-/ɔ/ and Spanish /o/. The author's study having an acoustic-oriented view examined F1 and F2 frequency values of Catalan and Spanish mid-back vowels. Concentrating his areal focus on the island of Majorca, the author, after having recruited two groups of Catalan-dominant and Spanish-dominant bilinguals of 10 speakers per group, engaged in the task of comparing mid-back vowel realisations produced both in Catalan and Spanish by all bilingual speakers. Comparisons between the two groups of speakers allowed to check for the presence of interaction patterns, classified by dominant and non-dominant phonetic subsystems, as these were developed into each language-dominant group. Different mid-back vowel patterns were supported by the analyses results, as reported in Simonet's study. An interesting vowel phoneme which held an intermediate position between the Catalan /o/-/ɔ/ contrast emerged from the speech analysis of Spanish-dominant speakers. They were found to display a two-category mid-back vowel system, the expected close-mid vowel for Spanish, along with the new feature used for Catalan that resulted from merging between /o/ and /ɔ/. Briefly, while failing to produce the /o/-/ɔ/ Catalan vowel contrast, Spanish-dominant bilinguals produced a single (merged) mid-back vowel different to their native Spanish /o/ in order to come up with a mid-vowel realisation as close as possible to the original Catalan mid-back vowel contrast.

1.2 Language variation

Having reviewed analyses of general concepts on language contact along with certain kinds of language contact process that take place in the Catalan/Spanish contact situation, we can now turn our attention to language variation. From the point of view of this section, it is vital to address all possible motivations for assessing language variation and change not only as the result of universal principles but also shaped by the social context in which it occurs (see Tagliamonte 2012: 3 with expansions in Labov 1963).

It soon becomes apparent when studying a dialectal continuum[8] as a range of language varieties spoken across a vast geographical area, at first sight these varieties seem to be slightly different between adjacent areas, but turn out to be quite different and may end up being no longer mutually intelligible at opposite ends of the same geographical area. On a geographic level, therefore, *diatopic variation* is the term used to describe variation in language. *Diachronic variation* deals with the development of a language; how it has changed, and still changes, over time. Changes over time are uniformly observed in the vernacular of everyday life, as well as in written language. A third type of variation employed in Sociolinguistics is variation across different classes in a society, named *diastratic variation*. From the perspective of persistent social interaction, which takes place in the societal framework, diastratic variation can be embedded in a society whose nature may range from a monolingual speech community to a plurilingual one. In bilingual situations, such as the one that characterises the city of Barcelona where one language (Catalan) succeeds another (Spanish), it is highly likely that diastratic variation appears due to *substratum* influence. Sankoff (2001) addresses the issue of *substratum* influence in Sociolinguistics with the primary focus on immigration. Among previous studies on *substratum* influence, she provides an overview of a quantitative study conducted by Fought (1999) on the 'u-fronting' typical of the English community. The study demonstrates that the pronunciation of /u/ by second-generation adolescents from the Mexican American community is readily distinguishable from the front vowel /u/ found in the speech of English speakers. The former group seems to have a systematic tendency towards backing of the /u/ vowel, which is consistent with the Spanish high-back /u/ vowel realisation. In this particular substratum case, Spanish formerly spoken by the Mexican American population has influenced their children's acquisition of English spoken later. It can be argued that, in learning English, Spanish-speaking monolinguals who belonged to the first-generation immigrants in the US, carried over certain phonetic features, which are reflected in Spanish.

Likewise, it can be assumed that Catalan spoken by second-generation adolescents whose families come from Spanish-speaking monolingual regions of Spain, their speech would be reasonably

[8] Leonard Bloomfield (1935) elaborating on the genuine term *dialectal continuum*, says that it comprises a range of dialects spoken across some geographical area that differ only slightly between neighboring areas, but as one travels in any direction, these differences accumulate such that speakers from opposite ends of the continuum are no longer mutually intelligible.

dominated by Spanish vowels. In other words, the second-generation Spanish-speaking group may produce various pronunciations of the Catalan words: *set*, 'seven', *dot*, 'gift' and *sacerdot*, 'priest'.[9] They may choose among vowels the close-mid-vowels /e/ and /o/ or an 'open-mid vowel-like' realisation that approaches /ɛ/ and /ɔ/, or, even less possibly, successfully pronounce the open-mid-vowels /ɛ/ and /ɔ/. It is more common to find substratum effects on Catalan from Spanish in areas where the Spanish-speaking immigrant group has become a majority of the local population.

Of all types of variation, *diaphasic* or *stylistic variation* is the most difficult to describe. This type of variation lies in the speech of individual speakers and encompasses a wide scale of registers, such as the formal speech style or informal (casual) speech. Examples of casual speech can be identified through the use of contractions and slang words in a conversation with friends while formal speech style often emerges in professional discussions. For instance, one makes complete sentences using specific words when interacting with a colleague about work matters. In stylistic variation, social factors (gender, age, education, language dominance and social class) contribute to the choice of vocabulary since these factors are considered to be responsible for higher or lower usage levels regarding the pronunciation of specific features.

1.2.1 Phonemic changes: mergers

Among the many studies on phonemic changes those which involve vocalic mergers occupy a special position in the literature. The term of *mergers*, is of interest for changes from within, which reflect that the phonemic distinction between two sounds, e.g. /e/-/ɛ/ and /o/-/ɔ/ no longer exists as sounds that were once distinct, merge into one. Labov, as opposed to contrastive vowel sets, introduces the following concept.

A *merger* is a change in the relations of two vowels in which one assumes or approximates the position held by the other (Labov 1994: 119).

The bulk of work has primarily concentrated on mergers as linguistic sounds, and vowels in particular, which are subjected to changes. Such changes may broadly involve a shift of one of the

[9] The corpus of the current study encompasses the words *set*, *dot*, and *sacerdot*.

vowels in vowel space. According to Hickey (Hickey 2004), vocalic mergers can be of two types, those that involve a shift of one of the vowels in phonological space and those that involve a change in the quantity of one of the two vowels. Both kinds are attested with context-sensitive mergers in the environment of sonorants.

The scholar differentiates between the terms *change in quality* and *change in quantity*. Hickey provides two typical examples of *change in quality* both found in English. The first example, which involves the word 'think', is often reviewed in English from a historical perspective of a merger in quality, marked by the raising of the vowel before syllable-coda nasals. In terms of the second example, which also reflects a change in quality, the word 'pen' is considered to imply a synchronically attested change before nasals in the American English variety of the Lower South and in the South-West Irish English variety, respectively. In short, these examples, which involve /ɛ/ merged with /i/ giving rise to /i/, have been offered by Hickey as an attempt to show mergers of the kind of context-sensitive, in the environment of sonorants. Moreover, a *change in quantity* underpinned by the same author, shows that the two long vowels found in the words 'horse' /hɔ:rs/ and 'hoarse' /ho:rs/ have been neutralised, once both are produced with a single short vowel.

Nevertheless, the previous examples offered to allow for context-related mergers could marginally find fertile ground in the present thesis project. This study deals with changes in quality in the Catalan vowels surrounded by obstruents and not by sonorants, contrary to the mergers environment suitably described above.

Another perspective is taken in Maguire, Clark, Watson and (2013), which adopt Martinet's (1952) and Hoenigswald's view (1960) that 'a merger refers to a kind of phonological change, whereby the distinction between two or more phonological categories is collapsed because of a loss of phonetic differentiation'. Here, as in other definitions, a merger refers to a loss of phonological opposition. Maguire's, Clark's and Watson's view has been expanded to the synchronic and diachronic state of a merger as well as to provide the reader with various degrees of merger in production, but not in perception, notions which will not be considered in the current study. Since vowel perception is beyond the scope of my thesis project interest, as a result there are no perception experiments involved in this study.

It is necessary though to consider the way mergers have been found to develop, even if through the acoustic analysis undertaken in this experimental work (see section 2.3), would not be possible to determine how mergers have taken place. Mergers as processes have been summarised by the authors as follows: a) *merger by drift* (*approximation*), b) *merger by transfer* and c) *merger by expansion*.

(a) Based on Harris (Harris 1985: 310) introduction to *merger by drift (approximation)*, where the scholar defines this type of mergers as 'two phonemes (x, y) in two sets of words (A, B) in a variety become one (z); their phonetic distribution gradually becomes more similar until they are no longer distinguished'. The development of a merger by drift (approximation) in the sense elaborated by Harris and revisited by Clark, Watson and Maguire is considered important in predicting instances of near merger phenomena, as the phonetic distribution of two phonemes may not completely end to be contrastive.

(b) Labov (1994: 321) formerly describes explicitly the process of a *merger by transfer* as 'words are transferred gradually from one phonemic category to another'. The development of a merger by transfer allows us to predict instances of merger phenomena, once Clark, Watson and Maguire stipulate that the final result of this kind of change is that all instances of the input phoneme are replaced by the output phoneme.

(c) The later authors underline that in *merger by expansion* an abrupt collapse between two phonemes takes place, whereby the phonetic space previously occupied by the two phonemes is now used for a single, unified one. This type of merger developed by expansion, not simply provides us with an insight about its very nature but primarily seems to facilitate comparisons across different generation groups of speakers. It is very likely to occur across a sample of the same dataset a situation in which bilingual speakers of a certain age group produce systematically the phonological distinction between two different sounds, unlike other age group(s), speakers of which fail consistently to use such a phonological distinction. The latter may have not acquired the distinction, even since their early childhood, and use the whole phonetic space for a single phoneme (see Maguire et al. 2013).

Evidence from the few available studies carried out in the city of Barcelona (see Lleó et al. 2007, 2008) shows mergers into the vowel space where vowels are laid out in a two-dimensional representation of front-back and high-low positions. Reduction in the size of the Central Catalan vowel system is, to a large extent, attributable to language contact. Despite language contact has not been shown to be part of the internal process of language evolution, the former assumption is not erroneous as its effects do. The presence of near-mergers and mergers conceived as the result of a linguistic process in tandem with the effects of language contact between Catalan and Spanish gives fertile ground for embarking upon this study in Barcelona.

1.2.2 Variability in mid-vowel production

A great deal of attention has been devoted to mergers in the previous section. As scholars have noted (see Harris 1985 and Maguire et al. 2013), in the development of a *merger by drift* (approximation), the phonetic distribution of two phonemes may not completely end to be contrastive. This leaves room for near-mergers to take place, though it does not necessarily exclude the possibility of mergers to occur, due to this change type by approximation. The study of Recasens and Espinosa (2009) forms a basis for near merger classifications based on spectral data from four minor varieties of Catalan. Despite processes of mergers also come into play from authors' data collected from their *Felanitxer*, *Gironí*, *Sitgetà* and *Rossellonès* corpus, our attention will be mainly focused on *near-mergers*. Hickey (2004) provides us with the following definition as this sheds light on what is the process involved in near-mergers.

A *near-merger* is found where a speaker consistently makes a small articulatory difference between items of two lexical sets but cannot distinguish these auditively, specifically when the pronunciations are offered to the speaker for evaluation. It must be emphasised that the essential crux of the near merger assumption is that speakers cannot hear the phonetic distinction which linguists tease out in a spectrographical analysis and by examining vowel formants through plotting F1 (Y-axis) against F2 (X-axis) (Hickey 2004).

In general, the case study cited in the present section represents differences across vowel system sizes of the varieties of *Felanitxer*, *Gironí*, *Sitgetà* and *Rossellonès* that are obvious, particularly

when recalling the seven-member and the eight-member inventories of vowel contrasts found in stressed syllables of Central Catalan and Majorcan Catalan, respectively. Less obvious, however, are changes in F1 and F2 frequency values, subtle changes which show what the position held by the /E/ and /O/ incoming vowels into the vowel space exactly is. Here, it should be noted that the vowel phonemes which result from the suppression of the opposition of the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs, are defined by the /E/ and /O/ symbols (see Recasens and Espinosa 2009: 241). An intriguing goal of their study was to reveal if the /E/ and /O/ vowels issued from the process of neutralisation show greater range of variability than their original counterparts. The process of neutralisation for these pairs of mid-vowels varies across each Catalan variety, see footnote 9 below for the examples of this listed in (a), (b), (c) and (d).[10]

One way to determine when symmetry in a given language variety occurs, would be by checking if vowel phonemes have been spread out evenly throughout the vowel space of the language variety under study. The following explanation may shed light on the issue as two outputs, which normally find themselves in the intermediate position of /E/ and /O/, emerge once both mid-front and mid-back vowel contrasts are under coalescence. Let us consider in this regard the symmetrical coalescence of the mid-front and mid-back vowels, as found in the varieties of *Sitgetà* and *Rossellonès*, in which a single mid-front vowel (/E/) is equivalent for the mid-back vowel (/O/). By way of contrast, *Felanitxer* and *Gironí* consist of examples of asymmetrical coalescence as mid-vowels in these varieties of Catalan do not show any tendency to spread as uniformly as possible within the phonological space. In this respect, in *Gironí*, the opposition of the close-mid-front /e/ with the open-mid-front /ɛ/ is preserved while the corresponding /o/-/ɔ/ vowel contrast changes into /O/. Conversely, in *Felanitxer*, the opposition of the close-mid-back /o/ with the open-mid-front /ɔ/ is retained while the corresponding /e/-/ɛ/ vowel contrast changes into /E/.

[10] (a) Felanitxer. The /E/ vowel phoneme arises from the loss of the mid-front /e/-/ɛ/ vowel contrast. The binary /o/-/ɔ/ vowel contrast can though be identified.
(b) Gironí. The /O/ vowel phoneme arises from the loss of the mid-back /o/-/ɔ/ vowel contrast. The binary mid-front opposition (/e/-/ɛ/) though can be seen.
(c) Sitgetà. None of the mid-front and mid-back vowel oppositions can be identified. By way of contrast, /E/ and /O/ subsequently arise from the loss of each contrast between the mid-vowel sets.
(d) Rossellonès. The loss of the mid-front vowel contrast seems to be subsequent to the loss of the mid-back one, which took place a few centuries ago (Veny 1983: 59). Once the mid-back vowel pair /o/-/ɔ/ became non-contrastive resulting in /O/, it steered towards neutralisation the mid-front vowel pair (/e/-/ɛ/). Thus, in Rossellonès, neutralisation was operating successively and ended up favouring symmetry with respect to the Rossellonès vowel system as follows: /i, E, a, O, u/.

One of the questions that arises with respect to neutralisation is, what determines which vowel contrasts are preserved and what causes two vowels to move and coalesce into one? Martinet (1970: 86-88) strove for a functional explanation of why specific vowel contrasts are well preserved but others not. According to Martinet, in the cases in which no loss of the opposition is observed, it happens in favour of the manner of speakers' articulation. Let us share Martinet's hypothesis who suggests that realisation of a specific vowel contrast may occur because speakers of that variety make use of a relatively small number of distinct articulatory movements. Martinet's insight finds support for the hypothesis of the /e/-/ɛ/ contrast preservation in *Gironí*. Speakers of this variety only produce the /e/-/ɛ/ distinctly. Such a distinction seems to be fairly opposed to the collapse of /o/-/ɔ/ contrast of the same Catalan variety since more complex articulatory movements are required to produce mid-back than mid-front vowels. By contrast, Martinet's hypothesis does not help to account for the preservation of the /o/-/ɔ/ contrast in *Felanitxer*.

It is interesting to consider that several speakers of the four Catalan varieties produced smaller contrast distances than the expected ones between mid-vowel pairs. Although this finding may not be consistent with a complete neutralisation process as a slight difference in height and peripherality is evident from authors' results (Recasens and Espinosa 2009: 252), it gives fruitful thinking in figuring out how accurately a speaker discriminates a contrast. Within this spectrum, it could be considered the extent to what perception influences production. In brief, when two phonemes approach each other so close that speakers are not able to make a distinction between them by listening, several perception experiments should be run for a plausible explanation to be provided. Assimilation experiment results would possibly depict the case of near-mergers regarding speakers who would have successfully perceived two distinct phonemes. Otherwise, experiment results of this kind would lead us to the case of mergers, if speakers' lack of contrast becomes apparent both through their speech production and perception.

Turning to the Catalan varieties cited in Recasens' and Espinosa's study, near-mergers come into play only once fine phonetic distinctions cannot be perceived despite a certain group of speakers in *Rossellonès* and *Sitgetà* acquired two finely distinguished versions of mid-vowel pairs. In particular, speakers' F1 and F2 frequencies allows to detect a small articulatory difference between /o/ and /ɔ/ in *Rossellonès* and between /e/ and /ɛ/ in *Sitgetà*. This small articulatory difference in

contrast to the anticipated result of mergers, shows near-mergers for /o, ɔ/ (F1 510, 500 Hz and F2 1046, 1012 Hz) and for /e, ɛ/ (F1 511, 532 Hz and F2 1793, 1755 Hz). It can be, thus, assumed that properties of each vowel pair cannot be distinguished perceptually between one another (see Recasens and Espinosa 2009: 252). However, fine phonetic distinctions between two segments are made despite speakers are not consciously aware of separating them out auditively. It can, thus, be established that both the F1 and F2 differences of these Catalan varieties, reflect a near merger scenario.

Data on the mechanics of neutralisation is presented whereby a two-stage neutralisation has been unfolded. Returning to the authors' assumption on whether the /E/ and /O/ vowels issued from the process of neutralisation show greater range of variability than the original /e/-/ɛ/ and /o/-/ɔ/ mid-vowel pairs, evidence (see Recasens and Espinosa 2009: 256) corroborates their hypothesis. By way of contrast, their results do not give support to the idea that the larger the vowel inventories are, the bigger the F1xF2 spaces and acoustic distance between vowels will be. To sum up, the process of neutralisation can lead to a wide range of variability, from limited insertion of new phonemes, either /E/ or /O/, to overt structural symmetry in the vowel space when both /E/ and /O/ are inserted. To gain further insight into neutralisation as a process, a cohort study may reveal the reasons why in *Felanitxer* and *Gironí* neutralisation has been impeded in *Stage 1* (vowel systems of both varieties have six peripheral vowels), whereas the vowel systems of *Sitgetà* and *Rossellonès* have proceeded with complete neutralisation in *Stage 2* (their vowel systems exhibit five peripheral vowels).[11]

1.3 The vowel systems of Central Catalan and Spanish

While the present section does not tackle the issue of dialectal division of Catalan in two major blocks (Eastern, Western Catalan), a brief discussion on such a division is deemed to be necessary,

[11] *Stage 1*. In Felanitxer, /ɛ/ moves towards /e/ and triggers loss of the contrast between these two mid-vowel phonemes; on that account alone, the upshot of the neutralisation process is that mergers by approximation, and most likely near-mergers as authors suggest, have been created. In Gironí, /o/ and /ɔ/ approach one another; their mutual move towards one another induces neutralisation which leads to near-mergers by approximation mutually ocurred.
Stage 2. It seems as though the mid-back vowel pair i.e. /o-ɔ/ of Rossellonès, whose contrast no longer exists, has steered towards neutralisation the mid-front /e-ɛ/ vowel contrast. Hence, it may be argued that a progressive neutralisation process takes place, through which /E/ subsquently emerges.

prior to the description of the four-height vowel system of Central Catalan along with the three-height vowel system of Spanish.

In 1861, Manuel Milà I Fontanals split Catalan into the Eastern and Western dialectal blocks under the criteria of phonology and morphology. Differences between Eastern and Western dialects lie at pronunciation and morphology that poses enduring questions about the conditions under which vowels are centralised. The Eastern Catalan language cluster includes the Central Catalan variety, which is a specific form of the Eastern Catalan block. Central Catalan is commonly spoken in the province of Barcelona, the eastern half of Tarragona province and, in the entire province of Girona. It has been noted that vowel reduction in unstressed syllables does not take place homogenously across the Eastern Catalan dialectal group. Based on the Central Catalan vowel reduction rule referenced in *Gramàtica del català contemporani* (Mascaró 2002: 92-93), it can be seen that /a/, /e/ and /ɛ/ produced in stressed position reduce to [ə] in unstressed syllables, while /o/ and /ɔ/ reduce to [u]. The following distribution of vowel phonetic realisations in stressed and unstressed syllables provided by Mascaró (2002: 96) is of central importance in understanding the relationship between the stressed Central Catalan vowel system and the unstressed one.

Fig. 1 Overall distribution of vowel phonetic realisations in Central Catalan

Stressed vowel system		Unstressed vowel system
i	→	i
e	→	
ɛ	→	ə
a	→	
ɔ	→	
o	→	u
u	→	

This seven-member inventory of vowel contrasts is not the maximal that can be found in stressed syllables of the Eastern Catalan block. In terms of phoneme inventory size, the Balearic variety of

Eastern Catalan, has eight (8) vowels in stressed syllables. The schwa (/ə/) is broadly present in Balearic Catalan in both stressed and unstressed syllables.[12]

Let us now consider the four-height vowel system of Central Catalan. Figure 2a depicts a system in which the close-mid-front /e/ in tandem with the open-mid-front /ɛ/ constitute a contrastive vowel pair in stressed syllables. Similarly, a minimal vowel contrast is retained between the close-mid-back /o/ and the open-mid-back /ɔ/ vowels. In unstressed position, on the other hand, the reduction rules referred to above result into a three-vowel susbystem with schwa and two high vowels (see Figure 2b).

Fig. 2(a) Four-height stressed vowel system of Central Catalan

height 4:	i	u
height 3:	e	o
height 2:	ɛ	ɔ
height 1:	a	

Fig. 2(b) Two-height unstressed vowel system of Central Catalan

height 2:	i	u
height 1:	ə	

In Spanish, there are no minimal mid-vowel contrasts to show since its system presents a single degree of aperture for the mid-front and mid-back vowels. A couple of mid-vowels (/e/-/o/) shares the second height degree while the third height position is occupied by another vowel pair, that of high-vowels (/i/-/u/). By way of contrast, the first height degree is solely occupied by /a/. Figure 3 below illustrates the three-height vowel system of Spanish.

[12] The stressed vowel /ə/ is absent from the speech production of several Majorcan citizens. People who live in *Sóller* as well as in the geographical locations of *Alaró*, *Lloseta*, *Binissalem*, and *Porreres* do not produce the schwa sound in stressed syllables (See Mascaró 2002: 104).

Fig. 3 The three-height vowel system of Spanish

height 3:	i	u
height 2:	e	o
height 1:	a	

In terms of size, Spanish has a five-member vowel inventory, whose number is inalterable in unstressed syllables. Spanish does not have the kind of vowel reduction that Central Catalan has. In spite of identifying a total of five vowel phonemes in Spanish that occurs in both stressed and unstressed syllables, its vowel system provides fertile ground for *allophonic variation*.

Let us look at this in more detail by defining first what *allophonic variation* encompasses. *Allophonic variation* is a term designed to describe a set of forms, which realise a phoneme when it occurs in certain phonetic environments. Before discussing any of the variant forms (allophones) a phoneme can realise, it is necessary to consider the sounds that are adjacent to it. Let us stress that Spanish vowel phonemes /i/, /e/, /a/, /o/, /u/ acting as allophones are not simply influenced to some degree by sounds found in the vicinity of them. The Spanish mid-vowel /e/, for example, has a lower [e̞] vowel realisation when contacts with /r/ (e.g. *guerra* [ˈge̞ra] ‘war’) but not so when followed by /m, n, t, θ, s/ (e.g. *ausencia* [auˈsenθja], ‘absence’). Consequently, [e] and [e̞] are in complementary distribution as these two sounds are not opposed to one another. This means that [e] and [e̞] are not found as two distinct sounds in the phonemic vowel inventory of Spanish but are heard as variants of the same vowel (/e/).

At this point, it should be reported that Spanish vowel phonemes alone have received little attention since the most studied aspect of the vowel system of Peninsular Spanish is the acoustic realisation of rising diphthongs (see MacLeod 2007). Even though both Catalan and Spanish include both falling and rising diphthongs, the present study only examines singleton vowel sounds that are treated as distinct from each other in Catalan. Furthermore, my discussion of language contact and ensuing borrowing from Spanish to Catalan explores from a qualitative viewpoint the behaviour of vowel phonemes and not allophones of the language(s) involved.

1.4 Social factors

This section intends to deliver an integrated discussion of the link between phonemic changes in cases in which mid-vowel pairs completely or partially merge and social factors. As noted previously, one of the goals of this study is to shed light on the strength of the effect of gender, age, language dominance and mother tongue on the mid-vowel pairs as these are conditioned by a set of linguistic factors: a) the preceding and following phonological contexts and b) the morphological structure of the word. An analysis of each key sociolinguistic variable will be thus provided as variation in speech is viewed against the background of each bilingual participant on the grounds of their social characteristics.

- *Gender*. Participants' gender has been of importance in variationist sociolinguistic studies as a link can be readily noticed between females/males and standard/non-standard language use. Scholars have been investigating gender as a driver of variation in language use through evidence based studies. The academic research and debate, vivid since 1922,[13] has reached the following conclusions: 'In careful speech women use fewer stigmatized forms than men, and are more sensitive than men to the prestige pattern' (Labov 1972: 243). 'Females show a greater sensibility to socially evaluative linguistic forms than do males' (Wolfram 1969: 78), 'Women on average deviate less from the prestige standard than men' (Cameron and Coates 1988: 13).[14] Much of the evidence we have for gender differences has pointed out that women's use of language is perceived to carry more prestige or to be closer to the standard variety than men's use of language. An important goal of the fieldwork in Barcelona is to gain an insight into the role of gender (female/male) in the process of language variation. It was therefore necessary to divide my corpus into female and male subgroups (see section

[13] Jespersen (1922: 247) argued that women, in comparison to men, demonstrated conservatism in their linguistic behaviour, whereas men seemed to be far more innovative in language using 'new' and 'fresh expressions'.

[14] Note that sociolinguists have repeatedly established theories on gender (or sex) which has always been subject to academic debates. Here, I summarise the following views concerned with the study of gender as this emerges through participants' observation in previous sociolinguistic fieldwork. 'Females show more awareness of prestige norms in both their actual speech and attitudes towards speech' (Wolfram and Fasold 1974: 93). ''Women, allowing for other variables such as age, education and social class, produce on average linguistic forms which more closely approach those of the standard language or have higher prestige than those produced by men. (Trudgill 1983: 161). Thus, gender, as a key social variable has been treated in a way that shifted the focus of women's conservatism in language use towards the idea that stylistic variation, namely, alternation of discourse structure to match the context and situation, lags behind women's use of fewer stigmatized and non-standard forms in comparison to men's language use.

2.2.2 for specific discussion of gender division) in order to check if the results of the present study on gender confirm the generalisation made from the scholars' observations cited earlier. In Chapter 3 I will examine if gender is correlated with the maintenance of the /e/-/ɛ/ and /o/-/ɔ/ vowel contrasts in Catalan, or merging of the mid-vowel contrasts occurs somewhat equally frequently in both men's and women's language performance.

- *Age.* It would be possible to come up with a number of terms associated with age in Sociolinguistics. Nevertheless, I would rather provide a set of necessary conditions to account for age grouping in the context of this investigation of how certain phonemes, such as open-mid-vowels can be identified in a certain age group and while these miss from another. I refer here to *age-stratified variation*, which may reflect a change in progress. Differences of the population sample chosen for participation in the study will be patterned among the speech of individuals of 15-34 years, 35-54 years and 55-75 years, indicating thus changes that have occurred over the past decades and subsequently bring generation differences into the analysis. Tagliamonte (2012: 44) argues that *generational change* is one of the cornerstones of sociolinguistics once innovations in all languages disperse slowly as new forms follow after older ones. The same author also adds that when linguistic features become evident in apparent-time and show age differences, they can possibly point toward the phenomenon of *age grading*. I will focus here on the definition of *age grading* provided by Labov:

  If individuals change their linguistic behaviour throughout their lifetimes, but the community as a whole does not change, the pattern can be characterized as one of age grading (Labov 1994: 84).

Features triggered by age-graded change typically exhibit a high degree of social awareness (Labov 1994: 111-112) and are prone to be consciously controlled. Thus, it is more likely dependent variables due to age grading to be semantic forms than phonetic features the current study aims to identify. I should remind the reader that the preservation or loss of certain Catalan vowels is from the perspective of apparent-time and simply reflects age-stratified variation. Age-

stratified variation will therefore become apparent in the current study by ranking hierarchically individuals into three age groups: a) youngsters and young people (15-34 years), b) middle-aged adults (35-54 years) and c) older adults (55-75 years) within the present-day society of Barcelona.

- *Language dominance*. The notion of *language dominance* will be employed in this study with the emphasis not laid upon the general approach of *linguistic dominance* and *social dominance* defined by Van Coetsem:

  Linguistically dominant is the native language of the agent, in this context called the first language (…) that is, the rl in rl agentivity and the sl in sl agentivity[15]. *Social dominance*, on the other hand, refers to the social status of the rl as opposed to the sl (Van Coetsem 1988: 13).

The term will be used beyond the scope of any transfer types, such as *borrowing* or *imposition* but will be treated as being strongly linked to the three dimensions for assessing language dominance Montrul (2016: 16) proposes: a) linguistic proficiency, b) input and c) context and use. The author takes the view that language proficiency is one dimension of language dominance stressing that the former term cannot be entirely equated with the latter. Language dominance, thus, first consists of the internal component of linguistic proficiency, the fact of having the skill and experience to master language(s). Second, input as an external component reflects the sheer amount of language(s) a speaker is exposed to in aspects of grammar and vocabulary development. A third functional component of the language dominance factor is, the context in which language(s) are spoken along with the way a speaker uses them to serve his/her communication needs. The concept of language dominance and its implications will be revisited in section 2.2.1. This notion will mainly prove important when analysing the feedback given by participants to the *Bilingual Language Profile* (BLP) questionnaire in the context of their language history, language use,

[15] By *rl agentivity* and *sl agentivity* Van Coetsem (1988) refers to the application of two transfer types, these of *borrowing* and *imposition*. These types receive full explanation by highlighting that *borrowing* refers to the transfer process of material from the *source language* (sl) to the *recipient language* (rl) of a speaker. In this process, a speaker's recipient language is the agent. This could be plainly realised by the case of a Catalan speaker using Spanish words while speaking Catalan. Imposition refers to the process in which the sl is the agent from where material is transferred into the rl of a speaker. The imposition pattern could be best outlined by the case of a Spanish speaker using his Spanish articulatory habits while speaking Catalan (see also Van Coetsem 1988: 3 for genuine examples from English and French).

language competence and performance and language attitudes (see section 2.1.4 of the present study). The classification of participants in Catalan/Spanish dominants will thereby lead to a division between 36 Catalan-dominant and 36 Spanish-dominant bilinguals with varying degrees of dominance among them, from high-scored to low-scored dominance in each of the two languages. The process of how each speaker's language dominance has been effectively assessed as well as all questionnaires employed in order to elicit my data will get attention in Chapter 2, which fully deals with methodological issues pertinent to the content of this experimental work.

- *Language acquisition and mother tongue*. Language acquisition, if not presented as Second Language Acquisition (SLA) is separated into two categories: *first-language acquisition* (L1) and *second-language acquisition* (L2). The term *first-language acquisition* (L1) describes the process by which an individual learns the first language in infancy. L1 is also considered to be native language or mother tongue. *Second-language acquisition* (L2) is distinguished from first-language acquisition (L1) by the fact that L2 is any language learnt other than an individual's native language regardless of stage of life e.g. infancy, early/middle childhood, adolescence. Previous research on the development of language in children have in common the assumption of fundamental similarities in their first-language acquisition. It is assumed that first language acquisition is a universal process that allows children to go through different stages of cognitive development. The study of children's language development can be carried out at several stages of language acquisition ranging from the 'babbling' and 'one-word stage' (6-18 months) to the later multiword stage (30+ months). Mark Liberman[16] presents how children gradually develop their abilities in speech production. The author begins by pointing out that in the 'babbling' stage, infants produce a series of repetitive consonant vowel (CV) patterns until the age of 30+ months when grammatical or functional structures emerge.

In this study, a common thread runs through most of the social factors involved (gender, language dominance and mother tongue), as another two-way distinction will give rise to a mother tongue

[16] Mark Liberman's lecture on First Language Acquisition is available on a lecture that appears to be a part of his online course (see section on-line sources for details).

grouping between individuals with Catalan-speaking parents and individuals with Spanish-speaking parents. The mother tongue factor will be thoroughly discussed in section 2.2.3. It should be noted though that instead of naming constantly the two groups by 'individuals with Catalan-speaking parents' and 'individuals with Spanish-speaking parents', these terms will alternate with 'Catalan speakers' and 'Spanish speakers' to determine both groups accordingly.

Moreover, in the present thesis, the acquisition of L2 is viewed from the perspective of bilingual acquisition by children who learnt the second language after the first one, in a context where both languages were used widely in the speech community. It can, however, be expected Spanish as well as Catalan to be informants' of the present study second language (L2) since infancy or early childhood. Bilingual acquisition from the perspective of adult second language (L2) will not be discussed in this study.

1.5 Hypotheses to be tested

In Chapter 2, the presentation of the quantitative methods I applied for investigating Catalan spoken in Barcelona by correlating mid-vowel variables in stressed position with gender, age, language dominance and mother tongue will be sufficient to build up the big picture of language differentiation in Barcelona. Before examining the way in which variation is embedded into the sociolinguistic context of this bilingual speech community, it is important to formulate my hypotheses about each sociolinguistic pattern. I shall thus start from the simplest patterns, which involve one social factor at a time and end up to the most complex, which involve multiple factors simultaneously. Since statistics are employed, conclusions about multiple factors will be drawn as more than one variable will be simultaneously examined. The main outcomes of study's experiments will be clearly delineated in the third and fourth chapters of my thesis project.

Hypotheses on the language dominance outcomes

Summing up first the sociolinguistic pattern involving language dominance, the sample is divided into 36 Catalan-dominant and 36 Spanish-dominant bilingual speakers. The following hypotheses can be formulated, even these will be confirmed or dismissed by the results.

- **In comparison to Catalan-dominant bilinguals, Spanish-dominant bilinguals are expected to produce near-mergers and mergers between /e/-/ɛ/ and /o/-/ɔ/ to a larger extent and to exhibit a smaller acoustic distance between the members of each vowel pair.**

I should second remind the reader that the current project employs an apparent-time methodology to compare among the three different age groups (15-34, 35-54 and 55-75 years). Nevertheless, if the speech of youngsters and young members of the community in question differs significantly from that of older members, it is possibly evidence of a change in progress to emerge through the current data. The question of whether variation in speech that is linked with the age of speakers reflects a change in progress will be addressed in section 4.3 of Chapter 4.

- **Spanish-dominant bilinguals of 15-34 years, with an early age of acquisition of the L2 Catalan language, are expected to preserve better the mid-vowel contrasts than Spanish-dominant bilinguals of 35-54 and 55-75 years, while differences across age groups are not expected to occur for Catalan-dominant bilinguals**.

Finally, theoretical explanations which provide ample support for the gender effect, allow me to predict that females shift more frequently toward the standard forms in careful speech than males. This assumption can be covered by the following hypothesis along with a second one, followed also by the effect of dominance:

- **Females are predicted to perform better in both /e/-/ɛ/ and /o/-/ɔ/ than males, and Catalan-dominant females to exhibit a better mid-vowel distinction than Spanish-dominant females.**

Hypotheses on the mother tongue outcomes

In order my data to be examined under the mother tongue condition, it was deemed essential to rearrange it. In section 2.2.3 I will elucidate the reasons why I decided to narrow down my data from 72 to 58 participants solely for the purpose of carrying out effectively the mother tongue

experiment. The data split into 30 participants whose parents are both Catalan speakers and 23 participants whose parents are both Spanish speakers will therefore provide us, among other comparisons, with a comparison between the performance of the Catalan-speaking and the Spanish-speaking groups in the same way as the language dominance experiment did. Mother tongue and language dominance are two core, though different, factors of my data analysis, for this reason, both have been subject to statistical tests and have been treated distinctly from one another. However, this sociolinguistic pattern will allow us to formulate similar hypotheses to language dominance.

- **Mid-vowel contrasts are predicted to occur more frequently in participants' speech whose parents are Catalan speakers than in the speech of participants whose parents are Spanish speakers.**
- **Spanish-speaking bilinguals of 15-34 years, with an early age of acquisition of the L2 Catalan language, are expected to preserve better the mid-vowel contrasts than Spanish-speaking bilinguals of 35-54 and 55-75 years, while differences across age groups are not expected to occur for Catalan-speaking bilinguals.**
- **Females are predicted to perform better in both /e/-/ɛ/ and /o/-/ɔ/ than males, and Catalan-speaking females to display a better mid-vowel distinction that Spanish-speaking females.**

The current chapter has been dedicated to provide the theory behind language contact and variation as well as to analyses of language phonemic changes predominantly engendered by social factors, as these were illustrated in previous case studies conducted by scholars. The results gleaned from the fieldwork experiments will be offered in Chapter 3. Chapter 4 will intend to push the questions of variation in dominant language and L1 performance forward a step but do not necessarily explain how far variation arose due to language contact and how far due to an inner-induced change in the vowel system of Central Catalan. A series of questions the present thesis project embarks upon are stated below.

1.6 Thesis plan

Chapter 1 has addressed the issues involved in the production of mid-vowel contrasts and phonemic changes and offered a discussion of the processes of language contact, language variation and change. Several case studies of contact-induced changes have illustrated the extent to what bilinguals in Catalan and Spanish tended not to differentiate the mid-front and mid-back Catalan vowels, when speaking in Catalan. Variability localised to the production of mid-vowels of certain Catalan varieties has also been attested. On the whole, Chapter 1 gave us an overview of the potential effects of social factors (gender, age, language dominance and mother tongue) on certain linguistic features (mid-vowels) along with devising a series of hypotheses that will be answered in the following chapters of the current project. I therefore go on with Chapter 2 that introduces the reader to the methods I applied to collect my data from the bilingual speech community of Barcelona. The second chapter is also devoted to a description of the procedure employed to elicit the vowel tokens of Catalan in tandem with stating certain problems faced during the acoustic analysis. Furthermore, it contains an analysis of the method used specifically for identifying the distance between mid-front and mid-back vowel pairs in acoustic space. The vowel formant normalisation procedure frequency values were submitted to, is detailed and Chapter 2 concludes with a brief presentation of the statistical analysis performed on the data.

Chapter 3 focuses on the two experiments, these of language dominance and mother tongue, and offers a full statistical analysis of the experiment results. A particularly insightful discussion takes place on the implications of social factors for the F1 frequency values of each vowel pair (/e/-/ɛ/, /o/-/ɔ/). Chapter 4 constitutes a discussion of any conclusions gleaned from the results as well as it is devoted to the emergence of phonemic changes in such a language contact situation. The same chapter, revisits the hypotheses stated at the end of the first chapter. Answers linked to the hypotheses and research issues are provided alongside recommendations for future research in order the gap in our knowledge around the mechanisms that trigger two distinct types of change (contact-induced and internal) to be filled regarding Catalan vowels and beyond the scope of this study.

Chapter 2

2. Method

The present chapter will outline the methods I applied to elicit my data along with reporting the sampling criteria that each participant was required to meet. Then, once speakers' selection and completion of the interview have been outlined, a number of experimental concerns in obtaining the Barcelona Catalan Corpus will be addressed. Experimental incidents in tracing the F1 and F2 frequency values of my target vowels will be identified, which tackle issues pertaining to vowel acoustic analysis. Acknowledging the necessity to document practices in corpus construction, Tagliamonte (2012: 100-108) provides examples from her own fieldwork and corpus building projects which are good references to begin with for further information on data collection techniques. The data gathering methods used in the present study were inspired by Labov's early work in New York City (Labov 1972), thus, a stratified random sampling procedure was followed. The effectiveness of this data elicitation technique, as well as common problems within such a random-sample survey, came into play and will be discussed in this chapter.

In section 2.1, explanations on the rationale for selecting a given number of participants (72), the time of data collection and its location will be offered, followed by a depiction of a random, stratified sampling procedure with social networking used on this study to collect data from Catalan/Spanish bilingual participants. All knotty problems will be addressed, starting with the unwillingness of elderly speakers to be recorded in the street, followed by the advantages the *snowball sampling technique* offered in general when conducting interviews, and in particular how that recruitment approach helped to sort out my sampling problems with older adults. Sections 2.1.1, 2.1.2, 2.1.3 and 2.1.4 will provide a detailed description of how an appropriate interview schedule was designed and why that type of design (a three stage interview) best fitted my experimental study as long as feedback questions and a reading-aloud task I implemented on my interviewees have been accomplished. Section 2.2 will determine the appropriate number of participants adjusted to the sampling design of the present research. Sections 2.2.1, 2.2.2 and 2.2.3 will cover discussion of the classification of bilingual individuals by language dominance, age and gender, and mother tongue. Section 2.3 will offer insight into the nature of the instances that were excluded from analysis; age-related misspellings, recording errors due to environmental noise and mispronunciations due to language interference (Spanish). The same section will introduce the

reader to the basic procedure used in the *Praat* software. It will be, thus, explained how the boundaries of each of the seven vowels were determined and their F1 and F2 values extracted. Section 2.4 will summarise the criteria applied relevant to the F1 and F2 frequencies with the goal of assessing vowel contrasts between close-mid and open-mid-vowels. Section 2.5 will present a vowel-extrinsic technique which involves the use of information from multiple vowels to normalise F1 and F2 values. Finally, section 2.6 will describe the statistical analysis procedure run on the data collected along the axis of language dominance and mother tongue.

2.1 The bulk of the Barcelona Catalan dataset

From 2014 to 2017, I collected the Barcelona Catalan dataset with the goal of finding bilingual subjects in Catalan and Spanish whose language performance would have been representative of the vernacular of the city of Barcelona in Spain. All subjects have been born, raised and educated in Barcelona and were recruited from the Barcelona metropolitan area. The present study treats the Barcelona metropolitan area as a relatively homogenous dialect area where, regarding Catalan, a single language variety is manifested by residents in a number of ways; used on a daily basis within the education system, through media and in the administrative services in which can also be drafted in Spanish.

The linguistic landscape of a language contact area such as the Barcelona city centre alongside municipalities that are formed in an official union of adjacent cities was my cornerstone for extracting data on language use. In particular, South bound city boroughs *L'Hospitalet de Llobregat* and *Esplugues de Llobregat*, which had been largely settled by domestic immigrants, have been proven to be interesting loca to study possible attestations of language variation in Catalan. Before establishing the method to target the seven stressed Catalan vowels, I decided to take a simple random sample of 72 bilingual individuals. To render the whole procedure successful, I wished to take a sample which would not be disproportionate. In doing so, my selected sample to represent the population was to be divided into 36 Catalan-dominant and 36 Spanish-dominant bilingual individuals, ranging in age from 15 to 75 years of age and divided among youngsters and young adults, middle-aged adults, and older adults. The individuals in each age subgroup would not outrate or be less than 12.

The random sampling technique was entirely successful regarding participants aged between 15 and 54. A satisfying proportion of the people I met at commercial centres, libraries and flea markets falling into the two first age groups were willing to participate in the study at that same moment. I found that, contrary to bilingual people aged between 15 and 54, older adults aged between 55 and 75 were mostly reluctant to be recorded and fill out there and then a questionnaire about their linguistic background. In the light of my unsuccessful attempts to randomly find and interview older individuals, I thought I could apply the snowball sampling technique[17] proposed by Schilling-Estes (2007). The great advantage of this technique formely developed by Milroy (1980; 1987), was that I could easily interview older bilingual adults once I share a common friend or acquaintance with them. I increased my chances of obtaining interviews with bilingual individuals aged between 55 and 75 as soon as I entered a Day Centre for elderly people, which helps them with tasks of daily living and leisure activities. After I spoke with the director, I secured her permission for conducting five interviews at the Day Centre frequented by bilingual people who fall into the third age group of the present study. I should acknowledge that older adults are by far more willing to spend an hour or so for an interview with someone who has been introduced to them by an acquaintance, than with a completely stranger.

All participants had no sensory problems, normal hearing and vision, as well as no history of cognitive or speech difficulties. Upon full completion of 72 interviews, I should underline that a randomly stratified sampling with social networking applied in tandem on this project provided a fully effective and efficient corpus-building pattern for interviewing bilingual individuals of different age groups. Ultimately, all recordings were made with a portable digital recorder (WS-550M) with a built-in stereo microphone.

2.1.1 The sociolinguistic interview

It is important to mention that the target vowels /e/, /ɛ/, /o/ and /ɔ/ along with /i/, /a/ and /u/ were elicited through a three stage interview. Once I had chosen Barcelona as a community of study, with Catalans and second generation domestic immigrants on being the types of people from whom

[17] The term *snowball sampling technique* refers to a recruitment approach known also as a *friend-of-a-friend approach* in network sampling defined by Milroy (1980; 1987), who contacted people that she knew to participate in a sociolinguistic research in Belfast. Her initial contacts, family, friends and acquaintances, introduced her to other people with whom had ties to the community under study.

I would intend to elicit my data, the next step was designing a generic schedule for an interview to approximate as closely as possible a casual conversation. Thus, a questionnaire was created including Frequently Asked Questions (FAQs) that were grouped into four topical areas (see section 2.1.2 which illustrates the four modules from A to D). Sticking to a strict order to asking these questions was not thought to be essential as sometimes rearranging the order of the topical areas let the conversation flow fairly naturally. Demography and languages, education, hobbies and family and bilingualism are believed to be topics of general interest and were selected as such, with the goal of minimising participants' attention paid to speech. Once participants' attention to speech was minimised by getting them involved in the topics previously mentioned, interviewees, having become less self-conscious about their language use, were ready to proceed from the first to the second part of the interview. Instead of a straightforward question-and-answer design, the second stage of the interview was designed to make interviewees read aloud a genuine text written in Catalan which included the target vowels following the conditions I describe in section 2.1.3. Section 2.1.4 highlights the third interview stage. The Bilingual Language Profile (BLP) questionnaire, as genuinely elaborated by Birdsong, Gertken and Amengual (2012), was administered to participants to point out their language dominance score in Catalan/Spanish and provide a concise overview of their bilingual profile taking into account a variety of linguistic variables that will be discussed in the same section.

2.1.2 The preliminary questionnaire

It has already been established that this thesis project intends for gaining insight into the effects of language dominance, age and gender, and mother tongue on the four Catalan mid-vowels. However, in order to get as clear instances as possible from the BLP pilot questionnaire (see section 2.1.4), the following preliminary questionnaire was distributed to 72 native Catalan-Spanish bilinguals, whose feedback on topics of general interest was registered. The Catalan version of the preliminary questionnaire can be found in Appendix A.

The FAQs questionnaire in English

A. Demography and Languages spoken with Family and Friends

Q1: What's your name?

Q2: Where are you from?

Q3: Where do you live?

Q4: How long have you lived in Barcelona?

Q5: What do you do for a living?

Q6: How many languages do you speak?

Q7: Once you grew up speaking more than one language, which is the language you speak with your family?

Q8: Which is the language you speak with your friends?

Q9: Where your parents are from?

Q10: What language(s) do they use?

Q11: Where your grandparents are from?

Q12: What language(s) do they use?

B. Education

Q13: What primary school did you attend?

Q14: What secondary school did you attend?

Q15: During your studies, what language(s) were classes delivered in?

Q16: How many hours of Catalan and Spanish are taught per week in primary and secondary school?

C. Hobbies and Family

Q17: Do you spend a lot of time with your family?

Q18: Would you consider yourself close to your family?

Q19: What do you do in your spare time?

Q20: Where do you spend most of your free time?

Q21: Could name a hobby that does not cost you anything?

D. Bilingualism

Q22: It has been estimated that more than half the world's population is bilingual, that is lives with two or more languages, what do you think about bilingualism?[18]

[18] For a summarised discussion, see Grosjean (2010).

2.1.3 The Catalan text[19]

The Catalan text was designed to encourage repeated vowel productions from participants as I expected to identify diverse instances of the seven Catalan vowels presented in bold type in the text below. The text is genuine, elaborated by myself. All instances extracted from the linguistic community in question were considered as language performance seen to be characteristic of Barcelona bilingual speech. A set of words, three per vowel, was presented randomly throughout the text.

*La **tassa** de cafè ha quedat intacta. L'Esteve es va estimar més no tastar-lo ja que havia deixat de fumar i de beure cafè durant els últims mesos. Faltaven uns minuts per a un quart de **set**, però ell es comportava com si **faltés** una eternitat. Ell tenia una **cita** amb l'Ester a un quart de **set** de la tarda. Pensava fer una **visita** al pis del Miquel cap a les nou ja que no vivia gaire lluny del cafè. El Miquel treballava al restaurant ´´**Set** Portes´´, un dels més emblemàtics de la ciutat amb més de **dos**-cents anys d'antiguitat. Va arribar d'hora a la trobada perquè, en general, solia ser puntual quan tenia una **cita**. En canvi, ella solia trigar quan en tenia una. El petit cafè on estava esperant-la es trobava al carrer Progrés número **2**, a pocs metres per **sota** de la plaça de la Reforma. Mentre pensava demanar una beguda que pogués tastar, una **tassa** de xocolata o un **batut**, per exemple, els seus ulls es van trobar amb els titulars del diari que hi havia al capdamunt de la pila de diaris de sota la taula. Va clavar els ulls al titular: ´´A **data** d'avui, a Espanya es venen més bicicletes que cotxes´´.*

*Últimament, ha pensat molt en comprar-se 'n una i, encara que li venien ganes de pedalar, calia tenir lloc per a desar-la. El seu pis era tan petit que no podia ni desar-hi la roba. A banda dels seus dots de ciclista, l'Esteve tenia un gran talent per a la música. El talent és un **dot** molt estimat. En canvi, el seu pare desitjava més que **completés** els seus estudis amb una carrera universitària de fisioterapeuta que no pas que dediqués la seva vida a la música.*

*De fet, ja havia rebut uns fonaments de música a l'orgue de l'església. En la seva **joventut**, volia convertir-se en un **sacerdot**. Després de completar els seus estudis a l'**Institut** de la ciutat, va*

[19] For the English version of the genuine Catalan text, see: Appendix B.

abandonar però la idea de fer-se sacerdot. La seva dona tenia gran habilitat per dibuixar. Ell va pensar que fóra millor que ella ***aportés*** *en dot sensibilitat, més que no pas que aportés en* ***dot*** *riquesa material.*

The production of the target Catalan vowels was elicited in a reading-aloud task performed twice, with the goal of circumventing orthographic effects that might have arisen during the first reading-aloud required process. Words exemplifying the two vowel contrasts of Central Catalan (/e/-/ɛ/ and /o/-/ɔ/) were selected for recording in such a way that the target vowels all occurred in similar Consonant-Vowel-Consonant (CVC) sequences, preceded by /d/, /s/ and /t/ and followed by /s/ and /t/. All four mid-vowels were found in stressed syllables. The Catalan words were either monosyllabic (/o/ *dos, /ɔ/ dot, /ɛ/ set*), disyllabic (/e/ *faltés, /o/ sota)* or trisyllabic (/e/ *completés, /e/ aportés, /ɔ/ sacerdot*).[20] In this guided part of the interview, the stressed vowels /i/, /a/ and /u/ drawn from the words *cita*, *visita*, *tassa*, *data*, *batut*, *joventut* and *institut* were also recorded and elicited within the same CVC frame.[21]

The sample of experimental items used in the reading-aloud task is presented in Table 2.1. The number in parentheses after each item indicates how many times that specific word appeared in the Catalan text. The words that appeared once were marked by number 1, those which appeared twice were marked by number 2 and those which were presented thrice by number 3. The sample stimuli thus represented three groups with ten items in the first *visita, faltés, completés, aportés, data, sacerdot, sota, batut, joventut* and *institut* (1), four items in the second *cita, tassa, dot* and *dos* (2), and one in the third *set* (3).

[20] The English translation for the Catalan words used in the text (*dos, dot, set, faltés, aportés, sota, completés, sacerdot*) is: 'two', 'gift', 'seven', 'was missing', 'was bearing', 'under', 'would have completed', 'priest'.
[21] 'Appointment', 'visit' 'cup', 'date', 'smoothie', 'youth' and 'institute' is the English translation of the Catalan words which include /i/, /a/ and /u/, following the same order as the one they appear in the Catalan text.

Table 2.1 Sample of the experimental items used in the reading-aloud task.

Catalan	**English**	**Target vowel**
cita (2)	‘appointment’	/i/
visita (1)	‘visit’	
faltés (1)	‘was missing’	
completés (1)	‘would have completed’	/e/
aportés (1)	‘was bearing’	
set (3)	‘seven’	/ɛ/
tassa (2)	‘cup’	/a/
data (1)	‘date’	
dot (2)	‘gift’	/ɔ/
sacerdot (1)	‘priest’	
dos (2)	‘two’	/o/
sota (1)	‘under’	
batut (1)	‘smoothie’	
joventut (1)	‘youth’	/u/
institut (1)	‘institute’	

The experimental data consisted of 7 target vowels x 3 word tokens x 2 repetitions that led to 42 responses elicited per individual. These 42 responses x 72 participants gave us a total of 3024 vowel tokens.

In the third and final stage of the interview, all participants completed the Bilingual Language Profile (BLP) detailed questionnaire regarding their language history, use, proficiency and

attitudes (adapted from Birdsong, Gertken and Amengual 2012). Participants were required to complete all sections of the questionnaire by placing a check in the appropriate box (for full list, see Appendix C).

2.1.4 The BLP questionnaire

In the bilingual community under investigation bilingual speakers have acquired Catalan and Spanish at various times during their lives, many speak one language less well than the other (Grosjean 2001: 10). The BLP questionnaire outline presented below administered to participants contained a number of questions (listed in Appendix C) pertaining to language history, language use, language proficiency and language attitudes. To assess language dominance, the ensuing schema found in COERLL's webpage[22] was employed in this thesis project, which effectively provides valuable insight into the structure of the most essential components of the BLP profile test to be used by anyone engaged in a language research.

Module 1: Language History

- Age of acquisition
- Age at which you became comfortable using each language
- Years of schooling in each language
- Years spent in a country or region where each language is spoken
- Years spent in a family where each language is spoken
- Years spent in a work or school environment where each language is spoken

Module 2: Language Use

- Percentage of use in an average week with friends
- Percentage of use in an average week with family
- Percentage of use in an average week at school or work
- How often you talk to yourself in each language
- How often you use each language when counting

[22] Center for Open Educational Resources and Language Learning (COERLL) of the University of Texas at Austin (see section on-line sources for details).

Module 3: Language Proficiency

- How well you speak each language
- How well you understand each language
- How well you write each language
- How well you read each language

Module 4: Language Attitudes

- Degree to which you feel like yourself when speaking each language
- Identification with cultures that speak each language
- Importance of using each language like a native speaker
- Importance of being mistaken for a native speaker

Based on speakers' feedback to the relevant modules, each participant was ascribed a dominant language. According to Birdsong, Gertken and Amengual (2012), language proficiency has been viewed as one of the four dimensions of language dominance and not been treated as equivalent to the concept of dominance. In the present study, besides the strong relation between language dominance and proficiency, the two concepts have been dealt with as separately as possible once a range of differences have been found to account for a set of distinct, yet interrelated components that language dominance comprises, such as linguistic, external and functional (see Silva-Corvalán and Treffers-Daller 2016). Even if growing up with two languages from birth has been acted as a selection constraint on identifying the subset of the population that would have presented that type of bilingualism (and not the type of bilingualism according to which individuals started learning a second language later in life), diverse aspects of bilingual experience, competence and performance in Catalan were important in determining whether someone is a good or a poor Catalan dominant and have been highlighted as such by completing the BLP profile test.

Timespan related to age, since when Catalan and Spanish had been acquired and used, was by far the predominant factor group, followed by the frequency of use and context in which both languages were used. In this dimensional classification, the functional components of linguistic and cultural identification were subsequent to the external ones, followed by linguistic proficiency, such as knowledge, competence and performance in both Catalan and Spanish. Note that

bibliographical information about the interviewees was retrieved from the BLP test regarding their age, meaning the actual age of the informants, gender and mother tongue, which let us next run a statistical model that included all those independent variables (See section 2.6). In doing so, the external, functional and linguistic components, predicted the extent to which the set of independant variables conditioned mid-vowels choice, such as /e/ instead of /ɛ/ and /o/ instead of /ɔ/.

2.2 Participants

Section 2.2.1 will primarily allow the reader to make rapid connections between Montrul's genuine definition of language dominance and the Bilingual Language Profile tool adapted to assess language dominance. The same section will allow the reader to gain a more in-depth understanding of (a) how the language dominance score was obtained per bilingual individual; and (b) the division of individuals into two groups (Catalan, Spanish) on the basis of their language dominance score. As participants were also controlled for the sociolinguistic variable of age in line with gender, in section 2.2.2 the reader will be able to interprete the link among age, gender and language dominance once the mean age of participants and gender split for each dominant group will be provided. Section 2.2.3 will remind the reader that language dominance has been of greater importance to measure than mother tongue in the present study. Nevertheless, mother tongue has stimulated sufficient interest to explore it by dividing participants into two groups. The analysis of language dominance and mother tongue to be intrinsically tied to speaker age and gender contrast will show whether language dominance culminates in a greater use of Catalan variants than mother tongue, or mother tongue ends with providing higher scores of the use of Catalan variants.

2.2.1 Language dominance

Montrul (2016) argued that language dominance appears to comprise three dimensions: linguistic proficiency and the other two being an external component (input) and a functional component (context and use). In accordance with Montrul's definition on the complex concept of language dominance, I suggest that dominance encompasses a wider range of aspects taking into account the four modules that have been reported in the BLP questionnaire. Considering thus language history as an external component (input), language use and attitudes as a functional component (context and use) and language proficiency as a linguistic component (ability and fluency), it has

been deduced that Montrul's original pattern fitted in with the four modules proposed by Birdsong, Gertken and Amengual (2012), designed to assess different dimensions of dominance.

The sample size of all 72 participants involved two equivalently sized groups: 36 bilingual participants who grew up speaking Catalan as a first language (L1) and 36 bilingual participants who grew up speaking Spanish as a first language (L1). Tables 2.2 and 2.3 illustrate the relative importance of each global score for Catalan and Spanish. The global scores of Catalan dominant (Table 2.2) and Spanish dominant (Table 2.3) bilinguals were established by a set of subordinate, yet important factors I analyse below, working together within each language dominant group (Catalan or Spanish).

Prior to dividing my sample into the two different language dominant groups, it will be useful to explain how I obtained the language dominance score per individual. A manual scoring procedure was followed and scores were averaged across the question responses in the BLP, which were associated with a number on a scale, as suggested by Birdsong, Gertken and Amengual (2012). This procedure also required to multiply the score for each section by a factor of: a) language history x 0.454, b) language use x 1.09, c) language proficiency x 2.27 and d) language attitudes x 2.27. Once all four factor groups were calculated, a total score has been yielded for Catalan and Spanish. The maximum possible score would be 218 for each language. Experimentally, the highest overall score of language total a participant may acquire can be in general determined from the analysis of the manual scoring procedure, as follows. Within the language history module, there are six questions.

(a) If the highest numerical value each question can be awarded are 20 points, the average of the 6 questions ends in 120 points. By multiplying the average of 120 points by the relevant factor of language history (0.454), as provided by Birdsong, Gertken and Amengual (2012), this ends in 54.48.

(b) The language use module contains 5 questions. If the highest numerical value each question can be awarded are 10 points, the average of the 5 questions ends in 50 points. By

multiplying the average of 50 points by the relevant factor of language use (1.09), it ends in 54.5.

(c) The language proficiency and the language attitudes modules contain 4 questions each. If the highest numerical value each question can be awarded are 6 points, the average of the 4 questions ends in 24 points for the language proficiency and 24 points for the language attitudes, calculated separately. By multiplying each average of 24 points by the relevant factor of language proficiency (2.27) and language attitudes (2.27), each module ends in 54.48.

Adding all module totals together (54.48+54.5+54.48+54.48), 217.94 is the highest global score a language can obtain. One language total was subtracted by the other to provide a dominance score that ranged from -218 to +218. You may notice that although Tables 2.2 and 2.3 present the sampling classification of language dominance of each bilingual group separately, all speakers were first grouped by their global score in Catalan and second by their global score in Spanish. The global scores reported in the same exact order seemed straightforward to interpret the split dataset into the participants who were dominant in Catalan and those who were not. Therefore, it was anticipated that the effect of negative numbers in Table 2.3 would be unavoidable for the Spanish-speaking bilingual group since subtracting a large number (Spanish bilinguals' global score in Spanish) from a small number (Spanish bilinguals' global score in Catalan) will always give a negative number.

Table 2.2 Sampling classification of language dominance of the Catalan-speaking bilingual group

Speaker	**Gender**	**Age grading**	**Global score for Catalan**	**Global score for Spanish**	**Dominance score**
NP	F	15-34	167.54	129.85	37.69
CL	F	15-34	172.174	126.124	46.05
GA	F	15-34	169.81	129.574	40.236
SE	F	15-34	169.266	148.936	20.33
IA	F	15-34	177.26	127.312	49.948
EM	F	15-34	158.55	155.374	3.176

JP	F	15-34	122.226	116.87	5.39
HP	M	15-34	168.086	136.476	31.61
AV	M	15-34	171.72	112.05	59.67
DR	M	15-34	166.27	132.67	33.6
JVA	M	15-34	156.858	94.806	62.052
ACC	M	15-34	175.622	144.922	30.7
PC	F	35-54	185.342	131.76	53.582
S	F	35-54	173.446	118.498	54.948
CE	F	35-54	154.38	102.62	51.76
RM	F	35-54	165.544	150.46	15.084
AT	F	35-54	177.168	132.3	44.868
GCM	F	35-54	148.926	115.776	33.15
AA	F	35-54	158.096	158.096	16.245
JS	F	35-54	185.07	149.83	35.24
JV	M	35-54	140.846	123.856	16.99
A	M	35-54	139.844	117.054	22.79
AC	M	35-54	203.56	111.52	92.04
MO	M	35-54	146.926	145.47	1.456
YS	F	55-75	164.184	127.124	61.582
MT	F	55-75	167.632	112.96	37.06
RB	F	55-75	154.282	114.602	54.672
CCB	F	55-75	166.092	66.535	39.680
MF	F	55-75	162.458	120.676	99.557
PM	F	55-75	158.008	96.248	41.782
MP	F	55-75	143.754	108.69	61.76
RMC	F	55-75	164.73	96.34	35.064
FM	M	55-75	132.674	81.86	68.39
JN	M	55-75	152.648	115.232	50.814
JPC	M	55-75	161.64	119.344	37.416
JF	M	55-75	174.718	119.04	42.296

Table 2.3 Sampling classification of language dominance of the Spanish-speaking bilingual group

Speaker	Gender	Age grading	Global score for Catalan	Global score for Spanish	Dominance score
AH	F	15-34	67.192	174.81	-107.618
ER	F	15-34	143.2	160.55	-17.35
MC	F	15-34	139.084	164.364	-25.28
JA	F	15-34	122.4	159.82	-37.42
BG	F	15-34	102.972	136.214	-33.242
IR	F	15-34	39.624	107.392	-67.768
PCR	F	15-34	133.938	151.31	-17.372
SA	F	15-34	108.236	177.624	-69.388
JB	M	15-34	127.032	174.716	-47.684
JPE	M	15-34	134.482	168.54	-34.058
HC	M	15-34	175.26	114.23	-61.03
DM	M	15-34	107.872	180.892	-73.02
OT	F	35-54	122.036	193.242	-71.206
MV	F	35-54	128.312	179.35	-51.038
GC	F	35-54	157.452	191.24	-33.788
MA	F	35-54	127.402	174.99	-44.588
SR	F	35-54	117.042	138.308	-22.266
SL	F	35-54	97.012	143.34	-46.328
EL	F	35-54	59.02	114.98	-55.96
SM	F	35-54	136.936	144.11	-7.174
MM	F	35-54	109.964	117.414	-7.45
LH	M	35-54	54.934	184.344	-129.41
JE	M	35-54	117.862	173.176	-55.314
OM	M	35-54	97.07	158.652	-61.582
AG	F	55-75	94.07	186.522	-92.452
AZ	F	55-75	44	248	-204
AM	F	55-75	90.383	171.904	-81. 521
EG	F	55-75	132.304	154.65	-22.346

EB	F	55-75	118.774	159.098	-40.324
MCC	F	55-75	73.368	186.794	-113.426
TB	F	55-75	66.754	162.002	-95.248
PT	F	55-75	126.218	164.36	-38.142
EP	M	55-75	74.18	148.294	-74. 114
AMP	M	55-75	62.11	136.31	-74.20
JAM	M	55-75	45.4	185.706	-140.306
J	M	55-75	133.49	140.75	-7.26

2.2.2 Age and gender

A sample size of 72 bilingual individuals participated in the study. This included 36 Catalan-dominant bilinguals[23] with a perfect balance among age groups.

- 12 youngsters and young adults, aged between 15 and 34,
- 12 middle-aged adults, aged between 35 and 54, and
- 12 older adults, aged between 55 and 75.

Participants of the Catalan-dominant bilingual group had a mean age of 43.7 years (SD = 16.9 years), 20 of whom were female with a mean age of 44.3 years (SD = 19.1 years), and 16 male with a mean age of 42.9 years (SD = 14.3 years). 36 Spanish-dominant bilinguals consisted of females and males and were also categorised by age following the same subdivision applied to the Catalan-dominant bilinguals. The Spanish-dominant bilingual group showed a mean age of 42.6 (SD = 18.3 years), 25 of whom were female with a mean age of 42.8 (SD = 17.6 years), and 11 male with a mean age of 42.2 (SD = 20.7 years). Along with their ages that ranged from 15 to 75 years, their language use differed according to the environment surrounding them such that some used to speak Catalan in the household/workplace but Spanish with friends while others followed the opposite pattern. All speakers were exposed to prolonged bilingualism on a daily basis.

[23] The notion of language dominance, even employed in a bilingual group oriented context (36 Catalan-dominant bilinguals and 36 Spanish-dominant bilinguals) but chiefly used to describe the individual speaker language dominance, has been defined in section 2.2.3.

The sample shown in Table 2.4 is made up of 72 individuals, all bilingual in Catalan and Spanish, ranging in age from 15 to 75 years of age and divided among 16 men and 20 women for the Catalan-dominant bilingual subgroup but 11 men and 25 women for the Spanish-dominant bilingual subgroup. While it has been kept in mind throughout this study to try and keep a perfect balance between Catalan-dominant and Spanish-dominant bilinguals across their three different age groups (n=12), the selection of individuals made upon their gender has been done randomly; as a result, it is not congruent with the symmetry the age-grading classification presents. This sort of asymmetry in number regarding the recruitment of 11 men versus 25 women for the Spanish-dominant bilingual subgroup, neither though generated problems in the interpretation of my dataset, nor forced me to follow alternative sampling strategies as soon as an oversampling effect had been reported for the female subgroup.

Table 2.4 Distribution of subjects by age and gender

Age	**Male**	**Female**	**Total**	**Language dominance**
15-34	5	7	12	
35-54	7	5	12	Catalan
55-75	4	8	12	
Total	16	20	36	

Age	**Male**	**Female**	**Total**	**Language Dominance**
15-34	4	8	12	
35-54	3	9	12	Spanish
55-75	4	8	12	
Total	11	25	36	

2.2.3 Mother tongue

The term *mother tongue* has been used in this study to describe the individual's home language and refers to the first language participants have acquired at home spoken by their parents, rather than learned at school or used in the speech community of Barcelona. It is worth to mention at this

point that I recruited participants by making explicit reference to their linguistic dominance[24] holding the view that individual's mother tongue is attenuated by their language dominance, because even if home is one of the places where languages are transmitted 'children acquire as first language the one that dominates in the milieu' (Calvet 2006: 159). However, I intended to remain open to considering four social factors (age, gender, language dominance and mother tongue) and evaluate them accordingly, as comparisons had been still possible to prove if variation was induced by mother tongue. Unlike language dominance by which our sample has been divided into Catalan and Spanish bilinguals, mother tongue gave rise to a four-way split of the sample. In the first instance, participants were categorised into speakers having,

- Catalan-speaking parents,
- Catalan-speaking father/Spanish-speaking mother,
- Spanish-speaking father/Catalan-speaking mother,
- Spanish-speaking parents.

Unfortunately, following that four-way subdivision of mother tongue, a markedly imbalanced gender distribution of bilinguals emerged, ranging from 57.14% women and 42.86% men (whose father is a Catalan) to 100% women and 0% men (whose mother is a Catalan). Tables 2.5 and 2.6 show this obvious discrepancy in the number of individuals classified by mother tongue. Although participants were grouped into one external factor, a division was made per individual based upon parents' origins, Spanish mother/Catalan father and Catalan mother/Spanish father.

[24] The notion of language dominance has been treated adequately in sections 1.3 and 2.2.3 and will be of key importance again, when analysing the fieldwork experiments in section 3.2.

Table 2.5 Overall distribution of mother tongue across individuals with Spanish mother and Catalan father. [25]

Speaker's name	Age group	Gender	Mother's origin	Father's origin
AZ	55-75	F	Zamora	El Tarròs
JS	35-54	M	Extremadura	Tarragona
SE	15-34	F	Galícia	Barcelona
SR	35-54	F	Extremadura	Barcelona
SM	35-54	F	Màlaga	Barcelona
ACC	15-34	M	Castella-la Manxa	Tarragona
LH	35-54	M	Andalusia	Barcelona

Table 2.6 Overall distribution of mother tongue across individuals with Catalan mother and Spanish father

Speaker's name	Age group	Gender	Mother's origin	Father's origin
EM	15-34	F	Barcelona	Sevilla
IR	15-34	F	València	Saragossa
MC	15-34	F	Catalunya	Galícia
EG	55-75	F	Lleida	Zamora
OT	35-54	F	Prat de Llobregat	Astúries
AT	35-54	F	Barcelona	Badajoz
MP	55-75	F	Castelló	Osca

Notice that there is some degree of overlap in both Tables 2.5 and 2.6 regarding the number of speakers (7 per group). Once a disproportionate number of males (none of men) appeared to have Catalan mother but Spaniard father, it was deemed necessary to narrow the subgroups of mother tongue down from four to two. This inappropriate subdivision has been reasonably created and actually makes sense under the view that informants' subgrouping into mother tongue was made after all 72 interviews had already been obtained and the sample had been partly examined in the scope of language dominance. Thus, I reckoned that a two-way distinction involving one group of

[25] Names of places providing information about parents' origin are all listed in Catalan. Despite the fact that some locations are found outside Catalonia, their names appear in Catalan to maintain uniformity.

Catalan-speaking parents and another, of Spanish-speaking parents, would be the best course of action to be carried forward as it would make the sample very easy to test directly.[26] In parallel with that broad division between Catalan and Spanish-speaking parents, the information represented in Tables 2.7 and 2.8 is associated with the place where the parents of the informants had been born and grew up.

Table 2.7 Overall distribution of L1 Catalan-speaking parents

Speaker's name	Age group	Gender	Mother's origin	Father's origin
AA	35-54	M	Barcelona	
AC	35-54	M	Vinaixa (Les Garrigues)	
A	35-54	M	Terrassa	Barcelona
AV	15-34	M	Barcelona	
BG	15-34	F	Barcelona	
CE	35-54	F	Barcelona	
CL	15/34	F	Cardedeu	
DR	15-34	M	Lleida	
FM	55-75	M	L'Hospitalet de Llobregat	
GA	15-34	F	Barcelona	
HC	15-34	M	Barcelona	
IA	15-34	F	Barcelona	Portbou
S	35-54	F	Barcelona	
JN	55-75	M	Barcelona	
JP	15-34	F	Barcelona	
JV	35-54	M	Barcelona	
MM	35-54	F	Barcelona	
MO	35-54	M	Lleida	
MT	55-75	F	Barcelona	
PCR	15-34	F	Barcelona	
RB	55-75	F	Barcelona	

[26] The issue of data's division into two mutually monolingual groups in terms of their mother tongue will be revisited and discussed in section 2.6.

YS	55-75	F	Barcelona	Tarragona
GCM	35-54	M	Esplugues de Llobregat	
HP	15-34	M	Barcelona	
NP	15-34	F	Barcelona	
PC	35-54	F	Begues	
RM	35-54	F	Barcelona	
JVA	15-34	M	Barcelona	
MO	35-54	M	Barcelona	
CCB	55-75	F	Barcelona	
MF	55-75	F	Barcelona	Tarragona
PM	55-75	F	Tortosa	Tarragona
JPC	55-75	M	Barcelona	
JF	55-75	M	Badalona	
RMC	55-75	F	Begues	

Table 2.8 Overall distribution of L1 Spanish-speaking parents

Speaker's name	Age group	Gender	Mother's origin	Father's origin
AH	15-34	F	Còrdova	
AM	55-75	F	Sant Sebastià	Toledo
EB	55-75	F	Navarra	Andalusia
EL	35-54	F	Galícia	
EP	55-75	M	La Rioja	Galícia
J	55-75	M	La Font de la Reina (Castelló)	
ER	15-34	F	Galícia	
JA	15-34	F	Extremadura	
JE	35-54	M	Andalusia	
JPE	15-34	M	Salamanca	
MA	35-54	F	Salamanca	
OM	35-54	M	Castella-la Manxa	
SA	15-34	F	Madrid	
SL	35-54	F	Ourense	

AG	55-75	F		Granada	
GC	35-54	F	País Basc		Andalusia
MV	35-54	F	Còrdova		Toledo
JB	15-34	M		Saragossa	
PT	55-75	F		Zamora	
AMP	55-75	M		Còrdova	
JAM	55-75	M		Astúries	
MCC	55-75	F	Múrcia		Navarra
TB	55-75	F		València	

2.3 Acoustic analysis procedure

This section will intend to provide a detailed description of the procedure used to extract the vowel tokens of Catalan in tandem with problems faced in the acoustic analysis. Identifying the /i/, /e/, /ɛ/, /a/, /ɔ/, /o/ and /u/ vowel tokens was a challenging task and involved a lot of listening practice chiefly due to the presence of a high variability in the speakers' vowel production in the current dataset. The manifestation of different, and, possibly erroneous, realisations of the same vowel, e.g. an open-mid-front [ɛ], a mid-front [ę] and a close-mid-front [e], showed that conditioned variants as such might have resulted from the complex interaction between age, gender, language dominance and mother tongue. Extreme F1 and F2 values falling outside the appropriate frequency range for a given vowel (see Recasens & Espinosa 2006), which were identified in the acoustic analysis, would not lie in the span of the robust phenomenon of vowel variation, despite the latter found in the dataset highlights the impact of interaction between factor groups and variants. These extreme values were re-measured by hand in order to ensure that the transcripts did not contain any obvious errors. Nevertheless, mismatches across words had to be discarded, as outlined below. I did not include in the analyses misspelled tokens that differed from the intended tokens by at least a certain character, i.e. a young adult (DM) and an older adult (J), both Spanish-dominant bilingual men, articulated with an alveolar /n/ the word '*dot*'. Similarly, a Spanish-dominant older bilingual woman (TB) misspelled the word '*tassa*' as '*tacha'*. A couple of misspellings also occurred when a Catalan-dominant middle-aged bilingual woman (CE) read '*completés'* and '*visita'* as '*contemplés'* and '*vista'*. Within the scope of Spanish influence, a middle-aged adult (MA) and an older adult (MCC), both Spanish-dominant bilingual women,

produced the Catalan /ɛ/ of the word '*set*' with a Spanish-like /e/ pronunciation. Not oddly enough, as both [sotə] and [sɔtə] exist in Catalan[27] the Catalan-dominant middle-aged male JV, quite reasonably made an unfortunate choice over the word [sotə] by pronouncing it as [sɔtə]. 11 participants (15.3% of my sample size), who represented the older adults group of the present study were reluctant to read aloud the Catalan passage a second time although no time constraints had been imposed. Whilst no low literacy levels amongst participants were observed, a few utterances needed to be excluded due to creaky voice or disfluences produced by the interviewees. Finally, on some occasions, I was unable to reduce environmental noise at my interview location.

All acoustic analyses were carried out with *Praat*, a freeware programme designed to analyse, synthesise and reconstruct acoustic speech signals[28]. Sound files with target vowels had been converted to a WAV format and then imported into *Praat*. *Praat* scripts were run to parse each participant's recording into individual files for each target item, and text grids were created.[29] Measurements were made following a quantitative research approach of experimental design.[30] Each target item was recorded twice, as a result each participant produced (65 x 2) 130 experimental tokens. A collection of vowel tokens (130 per participant) was therefore obtained from the acoustic analysis of all seven Catalan vowels for a total of 9.360 tokens. With respect to the dynamic range, the intensity settings in the spectrogram were configured at 30 (dB), which helped to eliminate soft background noises. The onsets and offsets of each vowel were determined, for each token, by looking into the waveform, spectrogram and the intensity curve. Then, the vowel temporal midpoint was calculated, and the centre of the frequency values was manually traced.

[27] Further meanings to the word *sota* should be considered as these appear in Catalan in the 'Diccionari Invers de la Llengua Catalana' (DILC): 1) *part inferior d'una cosa*, 2) *acció de submergir-se totalment en l'aigua* and, 3) *en cada coll del joc de cartes, carta amb el número 10 i la figura d'un patge*. An English translation concerning the meanings of the Catalan word is offered as follows: 1) under, 2) action to immerse yourself completely in the water and, 3) in any deck of playing cards, the card with the number 10 and a jack. Note that using *sota* in a context that holds the last meaning (3), this word should be pronounced with an open-mid-back vowel, ['sɔtə].

[28] *Praat* was developed by Paul Boersma & David Weenink at the Phonetic Sciences department at the University of Amsterdam. The current analyses were conducted with the use of version 5.4, 2014.

[29] Amengual (2014: 9).

[30] Following the Center's for Innovation in Research and Teaching (CIRT) four approaches to quantitative research (descriptive, correlational, quasi-experimental and experimental), the present project falls mainly into the type of experimental quantitative design.

Providing the (t_s) and (d_s) frames as examples of how easy to determine the vowel boundaries of my dataset was, it should be mentioned that vowel onset followed the voiceless stop burst and the offset was at the point of the onset of the patch of noise of the fricative consonant.

Figure 2.1 depicts a specific part of the waveform and spectrographic analysis after a typical 'cut & paste' option has been applied. Figure 2.2 illustrates more waveform and spectrographic patterns where the vowel boundaries of the /e/ (t_s) and /o/ (d_s) tokens have been identified.

Figure 2.1 Waveform and spectrographic patterns of manually marked vowel boundaries in vowel tokens

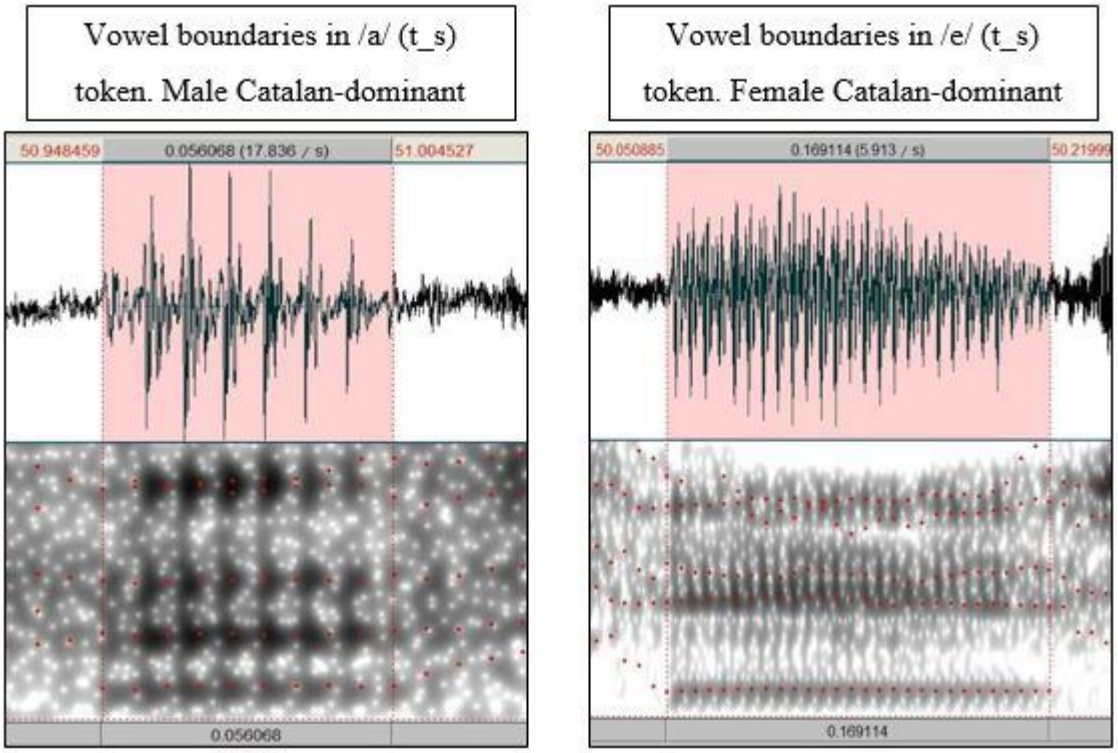
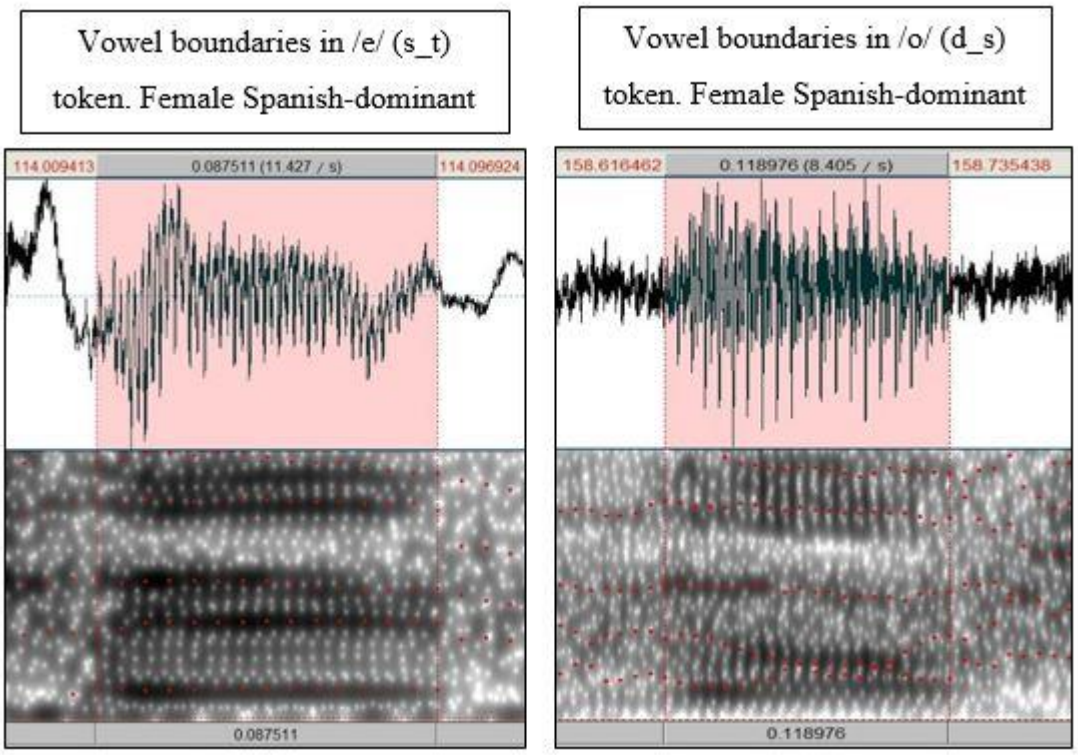


Figure 2.2 Waveform and spectrographic patterns of manually marked vowel boundaries in vowel tokens



2.4 The assessment of vowel contrasts between close-mid and open-mid-vowels

This section encapsulates the method for capturing the distance between mid-front and mid-back vowel pairs in acoustic space with the goal of providing information that illuminates the maintenance of vowel contrasts or a set of possible types of changes leading to (near-) mergers or lack of the mid-open vowels in stressed position as the /e/-/ɛ/ and /o/-/ɔ/ originally overlap.

At the outset, I have placed analytical importance on the methods for assessing the raw differences between mid-vowels in Catalan in order to present accurately the distance between /e/-/ɛ/ and /o/-/ɔ/ and their degree of overlap in acoustic space. F1 and F2 graphs, in which the values of the four variables are plotted along two axes, will reveal in the following chapter that the resulting points of these patterns illustrate the path of changes leading to (near-) mergers (whether one vowel is backing towards the other and which is the one that approximates the other). Through comparisons made on each vowel contrast, it will be described as precisely as possible the degree of overlap between mid-vowels in acoustic space. It was of vital importance to define, to a certain point, who

were the bilinguals of the data set whose language performance revealed that their mid-vowel realisations became very similar, but only up to a point; vowels still were distinguished (the case of near-mergers). The phonetic distribution of mid-vowels in acoustic space that gradually became more similar until they were no longer contrastive depicted the case of complete mergers.

Furthermore, it was revealed that assessing the F1 and F2 mid-vowel differences had helped to analyse statistically and provide socially compelling interpretations between the dependent variables and social factors. I also checked out the data I collected as a whole, to determine qualitative differences of the 21 words involved, as these where brought out into the open by examining the relationship between men and women, Catalan and Spanish bilinguals, and among the three different age groups. In order to compute vowel merging, a relative measurement of the formant distance was collected and calculated for each individual by subtracting /e/ from /ɛ/ and /o/ from /ɔ/ regarding F1, and /ɛ/ from /e/ and /o/ from /ɔ/ regarding F2. The mean F1 and F2 distances of the mid-front and mid-back vowels were then separately computed for the Catalan-dominant and the Spanish-dominant bilingual groups. The following criteria presented in Table 2.9 were applied in order to differentiate among full vowel contrasts and (near-) mergers with respect to the F1 and F2 frequency values.

Table 2.9 Criteria for classifying vowel changes across contrasts, near-merges and mergers.

Vowel contrasts	F1 > 50 Hz
Near-mergers	F1 = 25-50 Hz
Mergers	F1 < 25 Hz

Vowel contrasts	F2 ≥ 60 Hz
Near-mergers	F2 = 25-59 Hz
Mergers	F2 < 25 Hz

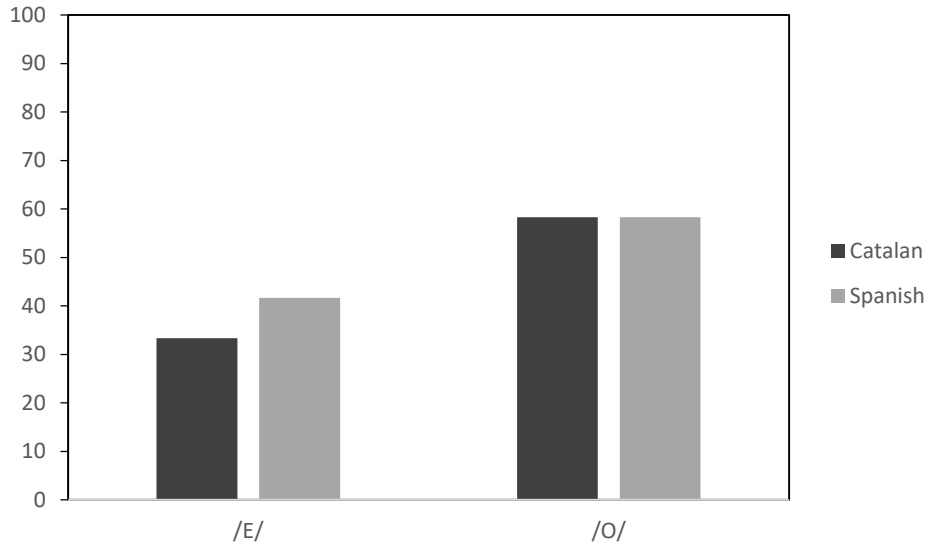
At first, the F1 frequency value comprised my main indicator because it is related to vowel height (the higher the vowel, the lower the first formant is and vice versa). The F2 frequency value on the other hand, being related to the degree of vowel frontness was not considered to be that critical to capture the acoustic distance between mid-vowels. A widely accepted view has been taken according to which, the F1 difference between the two mid-vowels in each pair should be more than 50 Hz to indicate a vowel contrast, whilst the F2 difference should be 60 Hz or higher (see Labov 1994 and Recasens and Espinosa 2009). On the other hand, near-mergers occur when the F1 acoustic distance falls between 25 and 50 Hz and mergers when it is less than 25 Hz. In addition,

when a given speaker's F1 showed complete mergers between mid-front and mid-back vowels but his/her F2 was higher in /e/ and /ɔ/ than in /ɛ/ and /o/, respectively, then those contrasts were classified as corresponding to a 'near-merger' situation following the F2 criterion; in other words, when F1 < 25 Hz but F2 = 25-59 Hz, this speaker produces near-mergers as priority has been given to F2. In a similar vein, when a given speaker's F1 showed near-mergers between mid-front and mid-back vowels but his/her F2 was higher in /e/ and /ɔ/ than in /ɛ/ and /o/, respectively, then those contrasts were classified as corresponding to a 'vowel contrast' situation following the F2 criterion; in other words, when F1 = 25-50 Hz but F2 ≥ 60, this speaker produces vowel contrasts as priority has been given to F2.

This procedure was partly unsuccessful. 58.34% of the Spanish-speaking dominant youngsters and young adults seemed to produce complete mergers[31] between the mid-back vowels while 58.33% (extremely similar!) of the Catalan-speaking dominant people of the same age group, showed evidence of fully merging between the mid-back vowels (see figure 2.3). Those, on the one hand, were not worrying proportions as later generation Catalan-dominant bilinguals (from 15 to 35 yrs) who reside in Barcelona may tend to produce /ɔ/ less systematically than the earlier generation groups, and this may fairly coincide with the percentage of Spanish-dominant bilinguals (from 15 to 35 yrs) who failed to produce the mid-back vowel contrast.

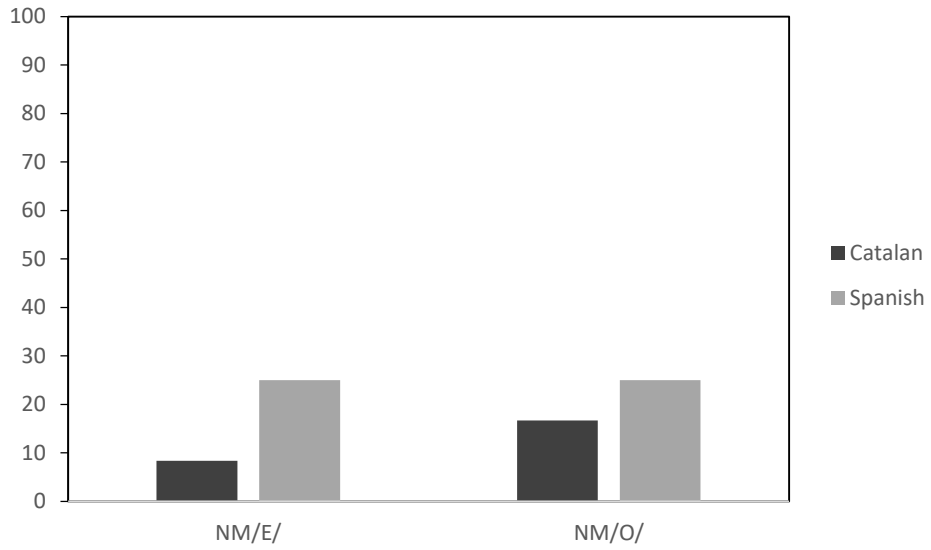
[31] Definitions on phonemic changes that affect the phonetic distinction between two sounds have been determined in section 1.2.1.

Figure 2.3 Per cent proportion (%) of mergers by bilinguals of 15-34 years, including both F1 and F2. The use of /E/ and /O/ abbreviations stands for mid-front vowel mergers and mid-back vowel mergers.



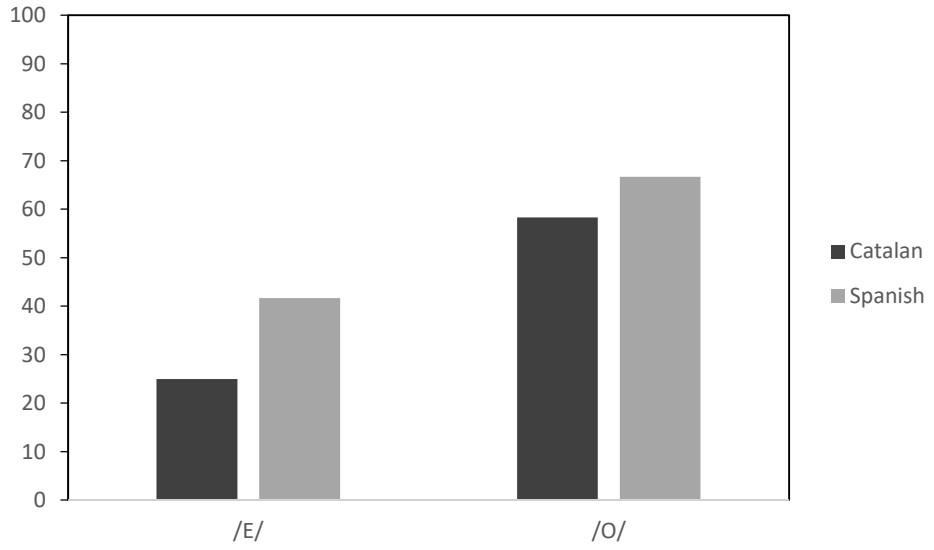
Evidence, on the other hand, propelled me to compare the total production of near-mergers for the same age groups taking into account both F1 and F2 values. Figure 2.4 illustrates that no mismatches were found between Catalan (16.67%) and Spanish (25%) youngsters and young adults who produced near-mergers.

Figure 2.4 Per cent proportion (%) of near-mergers by bilinguals of 15-34 years, including both F1 and F2. NM/E/ and NM/O/ stand for near-mergers of the mid-front and mid-back vowel pairs.



I thought it would be critical to know what the distribution of mergers would be within each bilingual group and across the three different age groups when only the F1 criterion for assessing vowel contrasts is applied. In the light of the findings in relation to the F1 criterion set out in percentages, as shown in Figure 2.5, 66.67% of the Spanish bilinguals and 58.33% of the Catalan bilinguals had merged /o/ with /ɔ/.

Figure 2.5 Per cent proportion (%) of mergers by bilinguals of 15-34 years, including exclusively F1. The use of /E/ and /O/ abbreviations stands for mid-front vowel mergers and mid-back vowel mergers.



This discrepancy can be explained by the fact that plenty of near-mergers upon the F1 criterion had been found in the production of youngsters and young adults of the Spanish-dominant group which according to the F2 values criterion their vowel tokens indicated vowel contrasts. It should be reminded that near-mergers were converted into vowel contrasts when speaker's F1 was between 25 and 50 Hz but their F2 equal to 60 Hz or higher. It should be reiterated that these F1 and F2 criteria applied in favour of the youngsters and young adults of the Spanish-dominant group because their near-merger rate was at 25%, distinctively higher than the near-merger rate of youngsters and young adults of the Catalan-dominant group (16.67%). The point of near-mergers finding favour among the phonemic changes on account of the F2 criterion, became the core of my argument to remove rates calculated based on the F1 and F2 criteria. I finally used solely facts that resulted from the assessment of phonemic changes between close-mid and open-mid-vowels based on F1.

2.5 The vowel formant normalisation procedure

F1 and F2 values of all seven vowels that are implicated in the data were submitted to a speaker normalisation procedure in order to minimise or eliminate acoustic variation in vowel measurements due to physiological differences[32], as these can be detected across individuals' output. It has been acknowledged that female speakers' vocal tracks are shorter, as a result their resonance frequencies are higher than male speakers' resonance frequencies. In the present thesis project, I first plotted the raw F1 and F2 values I displayed in Hertz for all 72 speakers and then I transformed them into normalised values in order to make them directly comparable without allegedly affecting or removing inter-speaker variation due to social category differences, such as age, gender and language variety.

The data normalisation procedure was carried out using the following formula introduced by Lobanov (1971):

$F_n[V]^N = (F_n[V] - MEAN_n)/S_n$

In the formula, $F_n[V]^N$ stands for formant n (F1 or F2 of [i], [e], [ɛ], etc. introducing one vowel at a time). $MEAN_n$ is the mean value, which is then calculated for each speaker by taking the overall mean of their F1 or F2 values across all vowels. To interpret the last part of the formula, S_n stands for the standard deviation (SD) for the speaker's F1 or F2 values across all vowels. This technique is vowel-extrinsic as it includes information from a range of vowels spoken by the same participant.

The analysis of the formula featured in Example 2.1 shows how effectively Lobanov's technique was used with a speaker's entire vowel system included.

$F_1/e^N = (F_1/e – MEAN_{F1}) / SD_1 => (490 – 505.4) / 96.78 = -0.2$, which is the normalised value for the F1 of /e/.

[32] Such differences in head/vocal track sizes have been reported by Fabricius (2008) in her attempt to highlight when and why one needs to normalise.

The formula application highlighted above has been used repeatedly (1.008 times). The last number derived from the fact that the 7 Catalan vowels gave an overall of 14 normalised values, 7 F1 x 7 F2 per individual. The global overall of instances ended in 1.008, as 14 was multiplied by the total number of individuals (72) who participated in the study.

2.6 Statistical analysis

Separate linear-mixed models (LMM) statistical analyses were performed on the F1 data for mid-front and mid-back vowels with subject as a random factor. Eight tests were performed. Separate tests were run on the formant frequency values for each vowel pair (/e/-/ɛ/, /o/-/ɔ/), for each normalisation condition (unnormalised, normalised), and for each language status condition (language dominance, mother tongue). The fixed factor conditions in each test were then as follows:

- front vowels, unnormalised, language dominance
- back vowels, unnormalised, language dominance
- front vowels, normalised, language dominance
- back vowels, normalised, language dominance
- front vowels, unnormalised, mother tongue
- back vowels, unnormalised, mother tongue
- front vowels, normalised, mother tongue
- back vowels, normalised, mother tongue

The factor levels were; for age ‘youngsters and young adults’ (15-34 yrs), ‘middle-aged adults’ (35-54 yrs), and ‘older adults’ (55-75 yrs); for gender ‘male’ and ‘female’; for language dominance ‘Spanish dominant’ and ‘Catalan dominant’; and for mother tongue ‘Catalan-speaking parents’ and ‘Spanish-speaking parents’. Post-hoc tests were run on the variable ‘age’ whenever it yielded a significant main effect. Significant two-factor interactions were also analysed statistically by testing whether a difference between the levels of a given variable achieved significance for a fixed level of the other variable. The significance level was set at $p < .05$.

Chapter 3

3. Results

In this thesis project, I have foregrounded the role of mid-vowel contrasts, near-mergers and mergers and intended to establish the connections between the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs and social factors (gender, age, language dominance and mother tongue). It is worth to remind that a perfect balance was kept during the interviews when selecting (Catalan/Spanish-dominant) bilinguals. Bilinguals were also divided into a symmetrical age-grading grouping, 3 age groups, each consisting of 12 Catalan and 12 Spanish-dominant subjects. Interviewees were selected randomly by gender, as a result the sample was not quite evenly divided by this independent variable. The number of females is not nevertheless widely divergent from the number of males. A further 'mother tongue' division was made for all 72 participants based on their parents' origins (Catalan/Spanish).

Section 3.1 provides the reader with a straightforward distribution scheme regarding vowel contrasts, near-mergers and mergers from a structural language dominance viewpoint. An analysis of the language dominance and mother tongue tests will be provided in sections 3.2 and 3.3 and their subsections to give a synopsis of the main effect and interaction which emerge from the statistical tests. Statistical analysis results establish that a change in the relation of the two mid-vowel pairs under study is mapped onto; a) gender, age and language dominance and b) gender, age and mother tongue.

3.1 A cursory look at the distribution of vowel contrasts, near-mergers and mergers across Catalan/Spanish dominants

Table 3.1 shows for the mid-front and mid-back vowel pairs how many Catalan dominant and Spanish dominant speakers produced vowel contrasts, near-mergers and mergers. It may be worth reminding the reader that the /e/-/ɛ/ and /o/-/ɔ/ representations stand for vowel contrasts, while /E/ and /O/ stand for near-mergers and mergers. Contrastive and non-contrastive vowel pairs were detected in the data sample, which comes from 36 Catalan-dominant and 36 Spanish-dominant bilingual participants between 15 and 75 years, born and raised in the city of Barcelona. The data collection method has been thoroughly described in section 2.1.3. The present section will sketch

a pattern that helps to understand how phonemically oriented changes are distributed throughout the data. In Table 3.1 below, 'YES' stands for vowel contrasts and 'NO' represents near-mergers and mergers.

Table 3.1 Breakdown of mid-vowel contrasts performed by Catalan and Spanish bilinguals based on language dominance (LD).

			e/ɛ		**o/ɔ**	
			YES	NO	YES	NO
LD Catalan		22	X		X	
		9	X			X
		2		X	X	
		3		X		X
LD Spanish		14	X		X	
		7	X			X
		1		X	X	
		14		X		X
Overall	**LD Catalan**		31	5	24	12
	LD Spanish		21	15	15	21

In Table 3.1 presented above, four possible outcomes with phonological implications in terms of vowel contrasts can be expected. In brief, the same table highlights how many of the Catalan/Spanish-dominant bilinguals retain the qualitative difference between both /e/-/ɛ/ and /o/-/ɔ/ and how many of each language dominant group make none of these distinctions. These two extreme outcomes, which are consistent with full maintenance or full loss of vowel contrasts, indicate 22 occurrences of full vowel contrasts maintenance for the Catalan-dominant group and 14 occurrences of full vowel contrasts maintenance for the Spanish-dominant bilingual group. Moreover, 3 occurrences of full vowel contrasts loss for the Catalan-dominant group, but 14 occurrences of full vowel contrasts loss for the Spanish dominant group, are featured in Table 3.1. To further analyse the same table, 9 Catalan-dominant bilinguals demonstrate maintenance of just the /e/-/ɛ/ vowel distinction while /o/-/ɔ/ has been merged into /O/. Similarly, 7 Spanish-dominant bilinguals show maintenance of just the /e/-/ɛ/ vowel distinction while /o/-/ɔ/ has been merged into /O/. Finally, 2 bilinguals of the Catalan-dominant group and 1 bilingual of the Spanish-dominant group just retain the /o/-/ɔ/ vowel distinction, while /e/-/ɛ/ has been merged into /E/.

Quite expectedly, the distribution of near-mergers and mergers does not spark our curiosity as the results are consistent with the prediction that Catalan-dominant bilinguals tend to favour the full mid-vowel contrast maintenance (22 speakers) whilst Spanish-dominant not (14 speakers). In addition, Spanish-dominant bilinguals are very prone to fully produce near-mergers and mergers (14 speakers), but Catalan-dominant bilinguals to a very limited extent (3 speakers). Nevertheless, a great number of Spanish-dominant bilinguals (21 speakers) preserve the mid-front vowel contrast, even if the latter group is outperformed by the Catalan-dominant bilingual group (31 speakers).

Ultimately, a thorough examination of Table 3.1 reveals that the /e/-/ɛ/ vowel contrast is better preserved by both language-dominant groups than the /o/-/ɔ/ vowel contrast which more often coalesces into /O/. The hypothesis genuinely formulated by Martinet (1970), and stated in section 1.4.3, seems to provide fertile ground for explaining why specific vowel contrasts are well preserved but others not. While it is still not clear how the collapse of the /o/-/ɔ/ opposition can be sufficiently circumscribed by specific articulatory and/or acoustic characteristics, this first set of results is getting interesting once the /e/-/ɛ/ vowel contrast production is highly differentiated from the /o/-/ɔ/ vowel contrast from a purely quantitative perspective.

3.2 Language dominance (Catalan/Spanish-dominant bilinguals)

Section 3.2 will deal with the statistical analyses results seeking to ascertain whether gender, age and language dominance have a significant impact on the mid-front/back vowel contrasts. Statistical results are presented separately according to the following logical grouping of them. They are given in two different sections. In section 3.2.1, the raw F1 analysis results for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs will be discussed, and in section 3.2.2 the normalised F1 analysis results for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs. The two sections will lead to a summary, which will trigger some brief discussion in Chapter 4, from where the final conclusion can be formulated.

3.2.1 Raw F1 values

3.2.1.1 Main effects

The statistical analysis yielded no main effect of both gender and age either for the raw F1 values for the /e/-/ɛ/ pair, or for the raw F1 values for the /o/-/ɔ/ pair. Such an absence of main effects, confirmed, when taken as a body, that female/male speakers as well as speakers of different age groups did not produce /e/-/ɛ/ and /o/-/ɔ/ significantly different. The results of gender and age shown in Figures 3.1 and 3.2 corroborate that these independent variables exert statistically non-significant effects on the /e/-/ɛ/ and /o/-/ɔ/ vowel contrasts. In the present chapter, the bar charts of all figures provide means of the F1 differences between the two vowels of each pair /e/-/ɛ/ and /o/-/ɔ/ but not the corresponding standard deviation values. The reason why is that the means of the dataset plotted in all bar charts of this chapter do not correspond to a single population sample, but to differences between two population samples.

Figure 3.1 Mean of the raw F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by gender

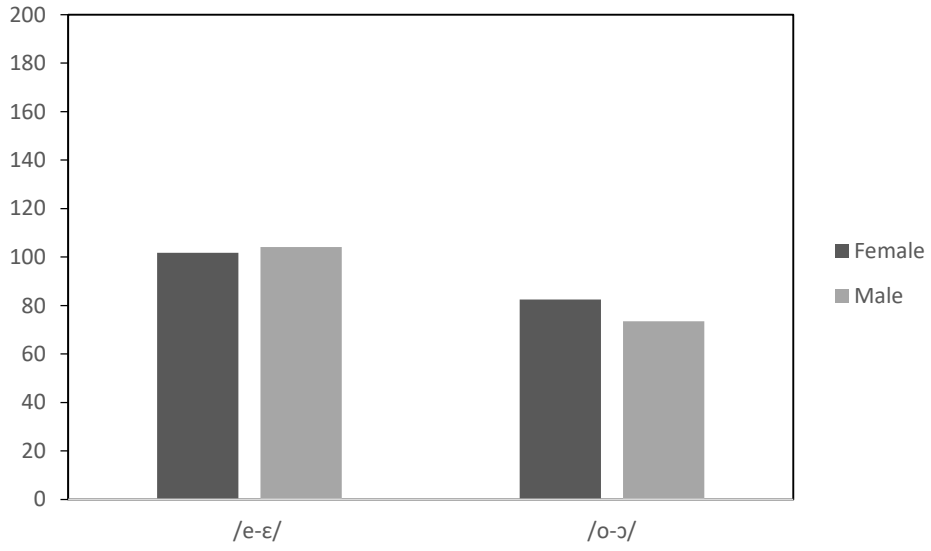
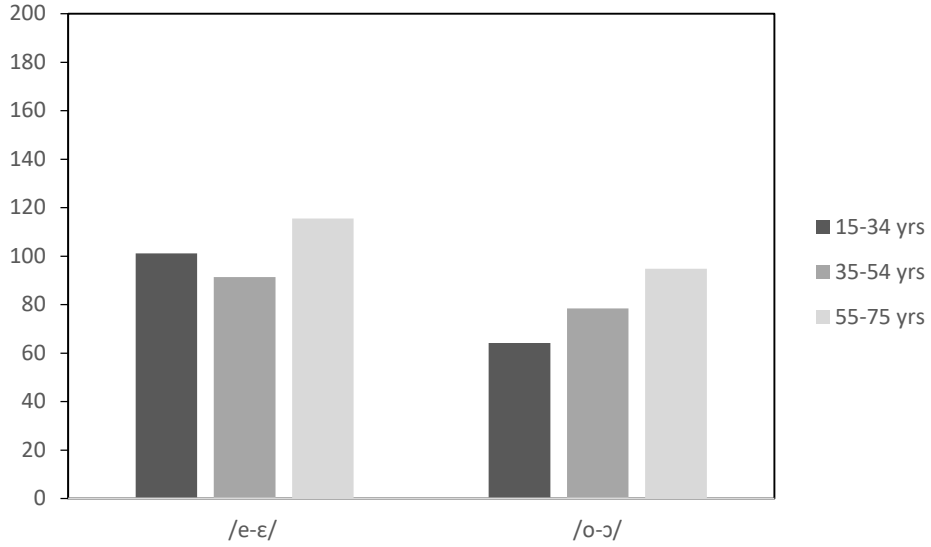


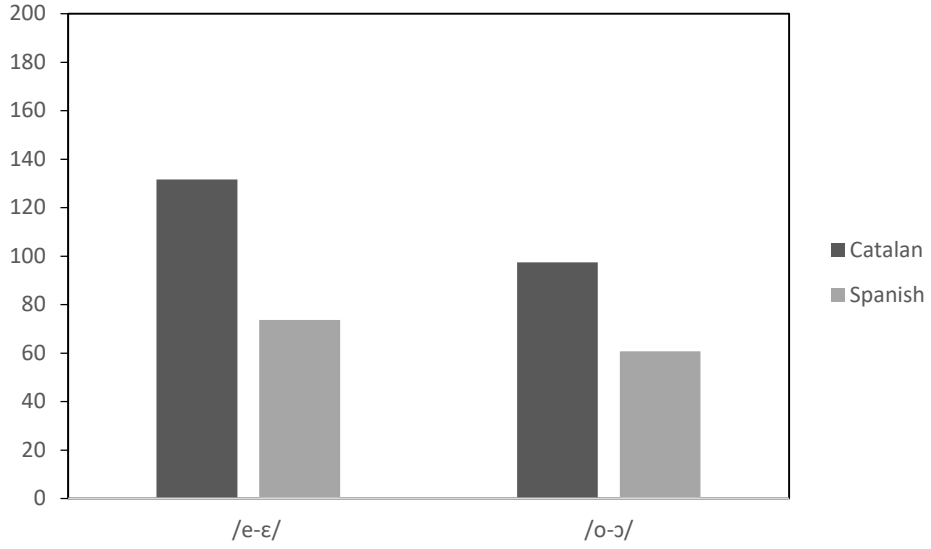
Figure 3.2 Mean of the raw F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by age



While age has been singled out as non-significant, fine-grained differences across the age group means plotted in Figure 3.2 reveal that all age groups display a higher F1 difference for /e/-/ɛ/ than for /o/-/ɔ/. Moreover, a sharp F1 difference can be noticed between youngsters and young people (15-34 years), with a higher /e/-/ɛ/ than an /o/-/ɔ/ difference. Likewise, the middle-aged adults group (35-54 years) displays a higher F1 mean difference for /e/-/ɛ/ than for /o/-/ɔ/. As regards the older adults group (55-75 years), fairly presents a mean difference of F1 /e/-/ɛ/ values higher than the mean difference of F1 /o/-/ɔ/ values. By and large, what becomes evident form Figures 3.1 and 3.2 is that both two gender groups as well as all three age groups show a greater acoustic distance between the /e/-/ɛ/ than the /o/-/ɔ/ vowel contrasts.

Conversely, there was a main effect of language dominance for the mid-front vowel contrast [$F(1,66) = 13.12$, $p. = .0006$] as well as for the mid-back vowel contrast [$F(1,65) = 6.16$, $p. = .0157$]. Figure 3.3 lets us consider the significant effect of language dominance, by highlighting the strength of the Catalan-dominant bilingual group in relation to the Spanish-dominant bilingual group. There was noted a greater F1 mean distance between /e/-/ɛ/ and between /o/-/ɔ/ for the former group of speakers when compared to the latter. Moreover, all bilinguals (Catalan/Spanish-dominant) show a trend for a greater acoustic distance between the vowels of the /e/-/ɛ/ pair than vowels of the /o/-/ɔ/ pair, which is more obvious for the Catalan-dominant group than for the Spanish-dominant group.

Figure 3.3 Mean of the raw F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by language dominance

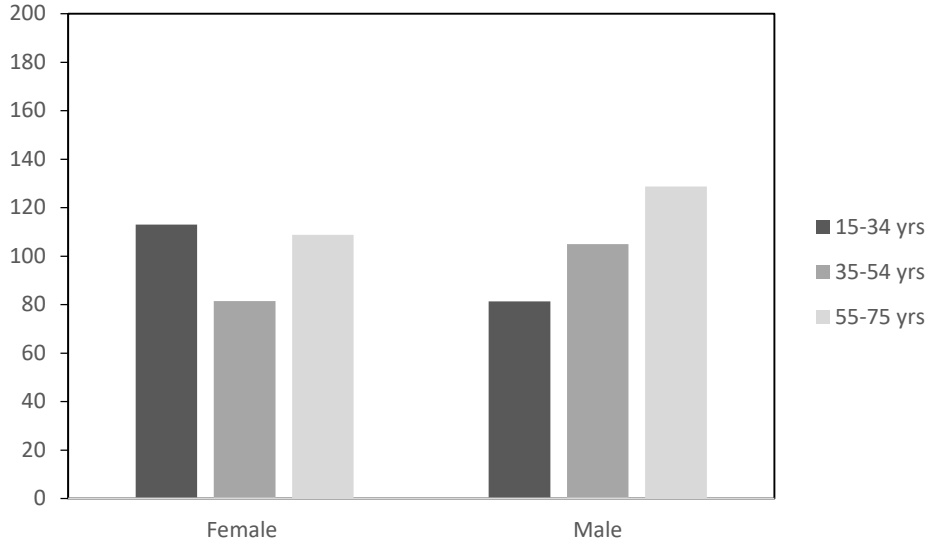


3.2.1.2 Interactions

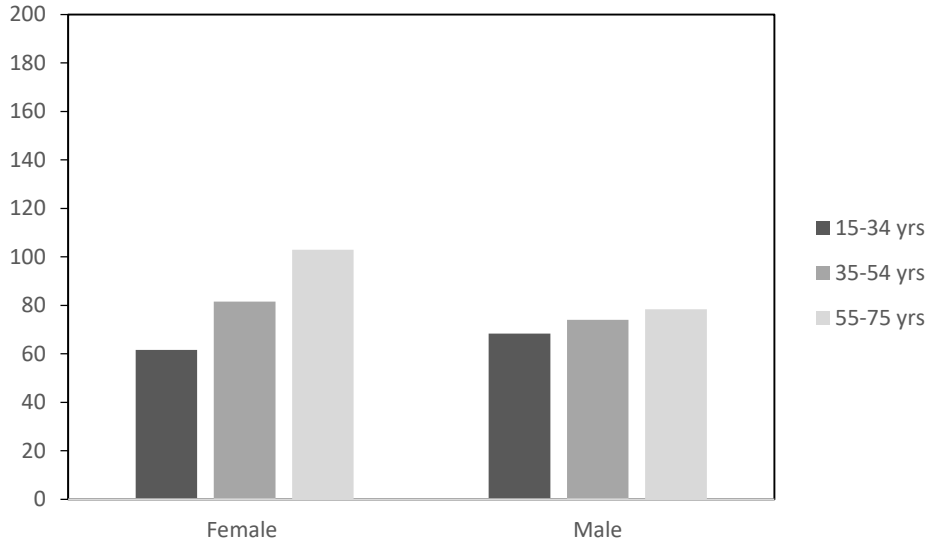
In order to gain a better understanding of how the effect of one independent variable depends on the effect of another fixed factor, results for the 'gender x age', 'gender x language dominance' and 'age x language dominance' interactions will be provided in a), b) and c).

a) No significant interaction was obtained between gender and age either for /e/-/ɛ/ or for /o/-/ɔ/.

Figures 3.4 Mean of the raw F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x age



Figures 3.5 Mean of the raw F1 differences for the vowel pair /o/-/ɔ/ conditioned by gender x age



In spite of the fact that 'gender x age' interaction yielded non-significant effects, the means of the dataset plotted in Figures 3.4 and 3.5 show several interesting trends. In Figure 3.4, a tendency is revealed for females of 15-34 years to perform better in /e/-/ɛ/ than males. Conversely, in the case of the /o/-/ɔ/ vowel pair, the prevailing tendency is for males of 15-34 years to perform slightly better than females. A systematically reversal trend emerges when looking at the mid-vowel pairs of females/males between 35 and 75 years, as illustrated in both Figures 3.4 and 3.5. Particularly, the female group of 35-54 years has a lower /e/-/ɛ/ difference but a higher /o/-/ɔ/ one than the male group of the same age. The findings for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs of the 55-75 age group

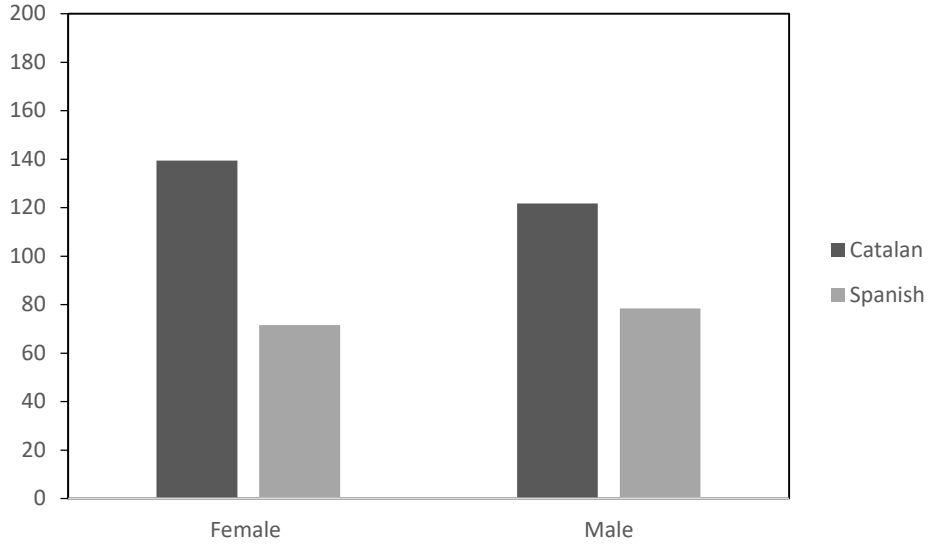
are in the same vein as the findings highlighted for the 35-54 age group. Once again, the female group of 55-75 years shows a lower /e/-/ɛ/ difference but a higher /o/-/ɔ/ one than the male group of the same age.

When the effect of age within each gender condition is taken into account, a gradually developed increase of the F1 difference for /e/-/ɛ/ can be noticed in Figure 3.4 in males from 15 to 75 years. Similarly, a symmetrical incline of the F1 difference for /o/-/ɔ/ can be noticed in Figure 3.5 in females from 15 to 75 years. From the perspective of further exploring trends within each gender group, the acoustic distance between the /e/-/ɛ/ vowel pair is greater for the female age groups of 15-34 and 55-75 years than for the female age group of 35-54 years. Within the male group, bars for the /o/-/ɔ/ vowel pair show quite similar means of F1 difference across age groups.

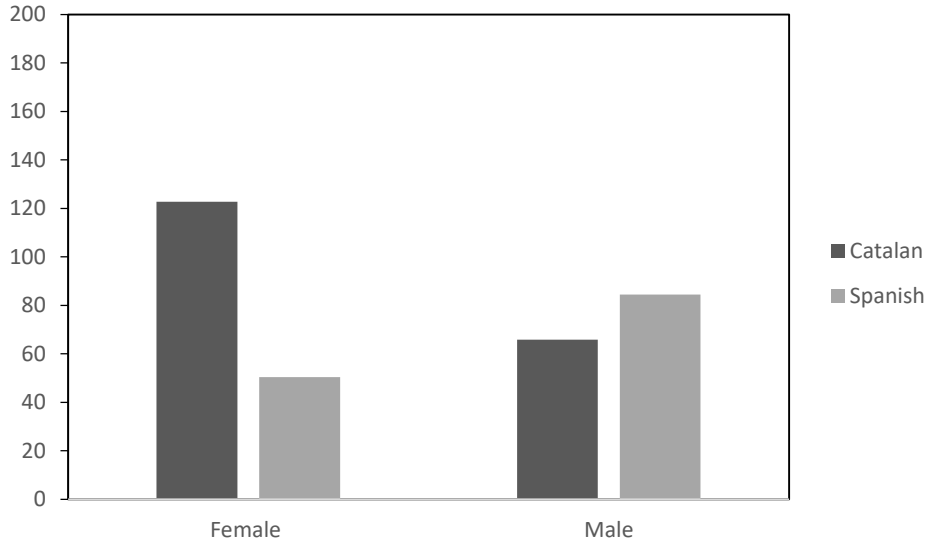
b) The 'gender x language dominance' interaction, on the other hand, achieved significance regarding the /o/-/ɔ/ pair, [$F(1,64) = 10.47$, $p = .0019$], but not for the /e/-/ɛ/ pair.

According to the pairwise comparison tests, the significant effect for the /o/-/ɔ/ pair was associated with a larger difference for Catalan-dominant females [$F(1,64) = 16.75$, $p = .0001$] than for Spanish-dominant females, unlike between Catalan-dominant and Spanish-dominant males no significant effect came out from their difference (see Figure 3.7). Moreover, as the same figure reveals, pairwise comparisons also yielded a significant difference between Catalan-dominant speakers of different gender [$F(1,64) = 7.54$, $p = .0078$] in the sense that females performed better than males. The difference between Spanish-dominant females and males did not achieve any significance.

Figures 3.6 Mean of the raw F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x language dominance



Figures 3.7 Mean of the raw F1 differences for the vowel pair /o/-/ɔ/ conditioned by gender x language dominance



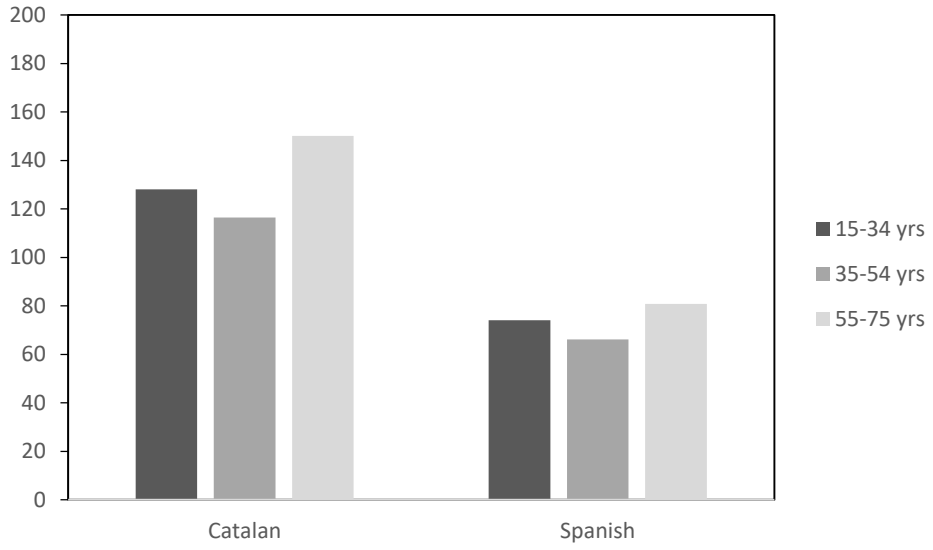
Figures 3.6 and 3.7 highlight the relative importance of trends, as these emerge from the 'gender x language dominance' interaction. A narrow range of means between Catalan-dominant females and Catalan-dominant males, as well as between Spanish-dominant females and Spanish-dominant males are reported in Figure 3.6 for the F1 /e/-/ɛ/ difference. In addition, a homogeneous trend of language dominance across gender is observed in Figure 3.6. Specifically, the difference between females of the Catalan-dominant and the Spanish-dominant groups along with the difference between males of the Catalan-dominant and the Spanish-dominant groups are evenly preserved.

By way of contrast, the correlation between gender and language dominance exerts a strong influence on the use of the mid-back vowel contrast. In fact, Figure 3.7 shows that Catalan-dominant females produce the mid-back vowels with a strikingly higher F1 difference than males of the same language dominance group, while, even less evidently, are males the ones who present a greater F1 difference than females in the Spanish-dominant group. Moreover, there appears to be a clear trend for Catalan-dominant females to show a higher F1 difference than Spanish-dominant females while Catalan-dominant males present a lower F1 difference than Spanish-dominant males.

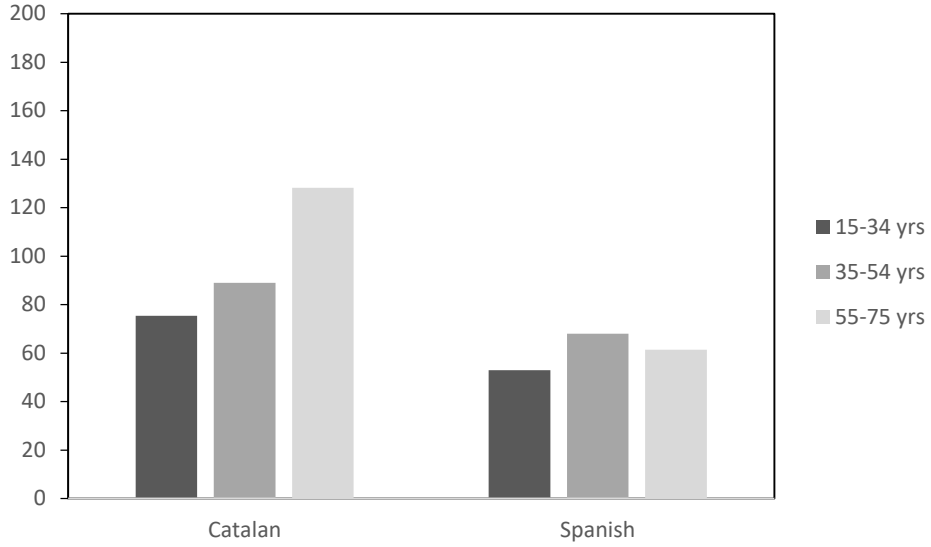
In general, the mean of the Catalan-dominant bilinguals shows that the tendency is for them to have a higher values difference on the mid-vowels than the Spanish-dominant bilinguals, with one glaring (albeit non-significant) exception. Catalan-dominant males exhibit an unexpectedly lower average of F1 /o/-/ɔ/ difference than Spanish-dominant males.

c) The interaction of 'age x language dominance' for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs was non-significant.

Figures 3.8 Mean of the raw F1 differences for the vowel pair /e/-/ɛ/ conditioned by age x language dominance



Figures 3.9 Mean of the raw F1 differences for the vowel pair /o/-/ɔ/ conditioned by age x language dominance



Figures 3.8 and 3.9 show several trends in 'age x language dominance'. Predominantly, the acoustic distance between the vowels of the /e/-/ɛ/ and /o/-/ɔ/ pairs is greater for the Catalan-dominant group than for the Spanish-dominant group across all age groups. Furthermore, within the Catalan-dominant group, the acoustic distance especially for the /o/-/ɔ/ vowel pair, increases progressively across age groups. The older Catalan-dominant bilinguals are, the better they perform in /o/-/ɔ/. As to the Spanish-dominant group, the F1 difference does not seem to develop gradually across age grading for neither /e/-/ɛ/ nor /o/-/ɔ/.

3.2.2 Normalised F1 values

3.2.2.1 Main effects

The statistical analysis yielded no main effect of gender and age either for the normalised F1 values for /e/-/ɛ/, or for the normalised F1 values for /o/-ɔ/. These effects are congruent with the raw F1 statistical analysis results. Figure 3.10 depicts that the mean differences for /e/-/ɛ/ and /o/-/ɔ/ for females is quite close to the corresponding differences for males. Figure 3.11 also highlights strong similarities of F1 difference for /e/-/ɛ/ across age groups. Particularly, the F1 mean differences among youngsters and young people, middle-aged adults and older adults show some degree of overlap specifically between the groups of youngsters and young people and older adults. In terms of the F1 differences for /o/-/ɔ/, they are identical for middle-aged adults and older adults, but slightly lower for youngsters and young people. Overall, the normalised F1 difference is consistent

with the raw F1 difference, as both corroborate that the acoustic distance is steadily higher for /e/-/ɛ/ than for /o/-/ɔ/ across different gender/age groups.

Figure 3.10 Mean of the normalised F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by gender

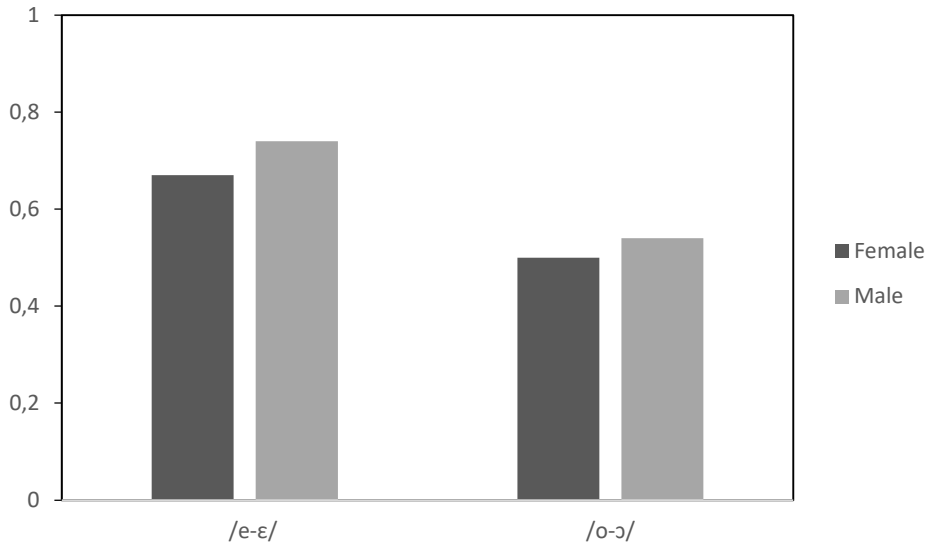
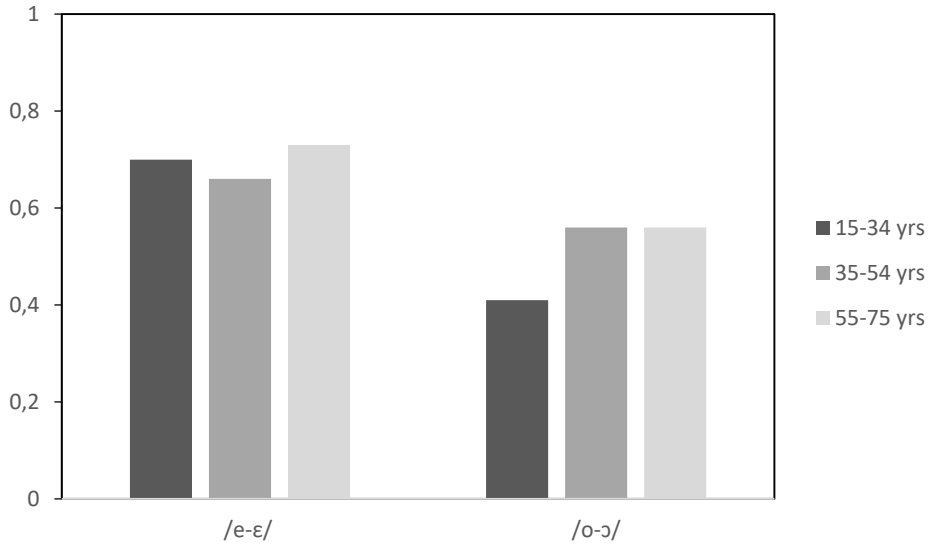


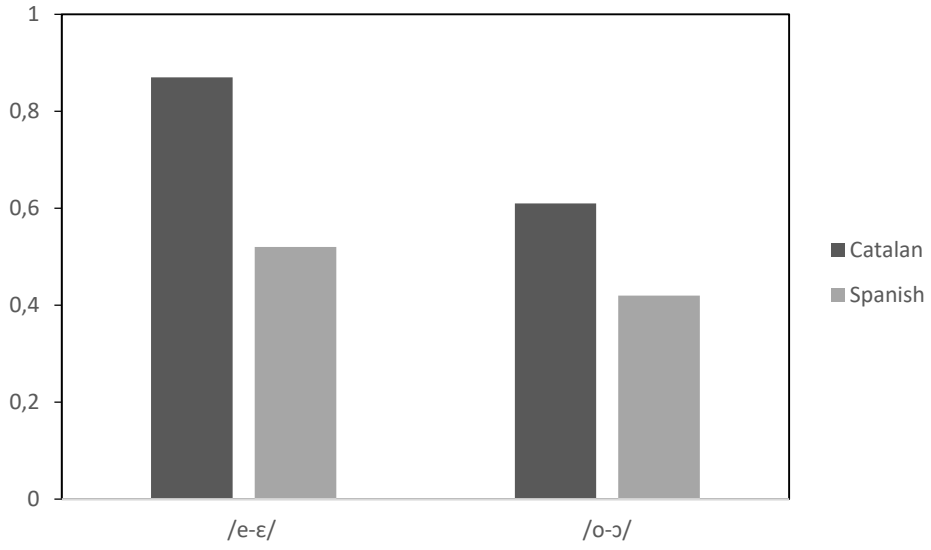
Figure 3.11 Mean of the normalised F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by age



The statistical results supported the finding of a main effect of language dominance for /e/-/ɛ/ [F(1,67) = 12.59, p = .0007], but not for /o/-/ɔ/. Nevertheless, in the case of the raw F1 values (see section 3.2.1.1) the difference between the vowels of the mid-front and mid-back pairs achieved significance. Figure 3.12 highlights the main effect of language dominance. It particularly reports

a larger gap between the mean of the F1 /e/-/ɛ/ difference conditioned by Catalan-dominants, in comparison to that of the F1 /e/-/ɛ/ mean difference, conditioned by Spanish-dominants. Nevertheless, the gap is narrower between the F1 /o/-/ɔ/ mean difference of the Catalan-dominant group and the F1 /o/-/ɔ/ mean difference of the Spanish-dominant group. In general terms, both the normalised and raw F1 differences, show a clear trend for a greater acoustic distance between the vowels of the /e/-/ɛ/ pair than for the vowels of the /o/-/ɔ/ pair across language dominance conditions.

Figure 3.12 Mean of the normalised F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by language dominance



3.2.2.2 Interactions

a) No significant interaction was obtained between gender and age either for /e/-/ɛ/ or for /o/-/ɔ/, as illustrated in Figures 3.13 and 3.14.

Figure 3.13 Mean of the normalised F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x age

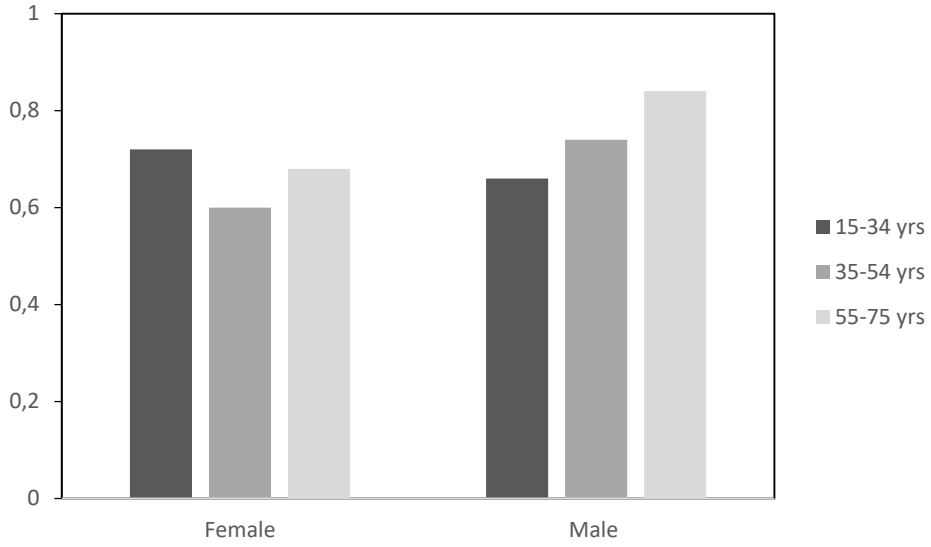
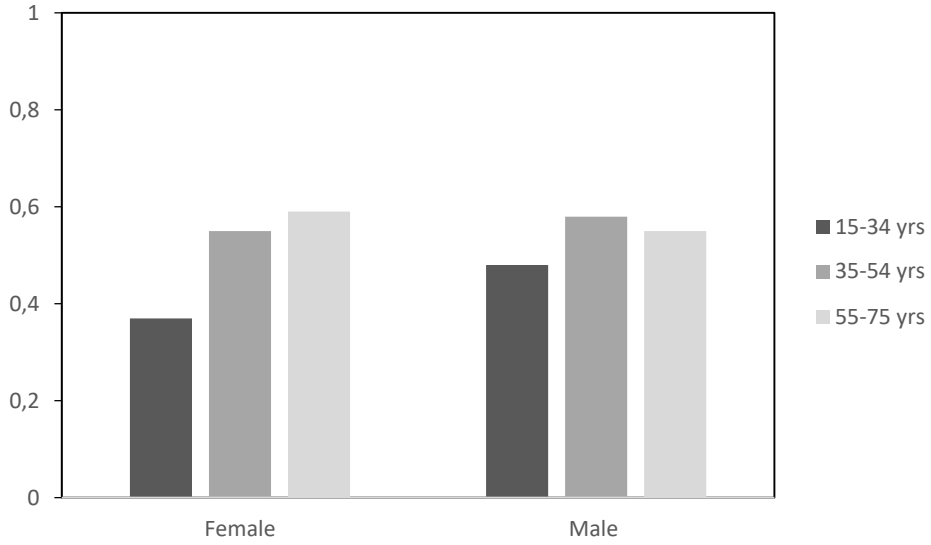


Figure 3.14 Mean of the normalised F1 differences for the vowel pair /o/-/ɔ/ conditioned by gender x age



Besides the absence of a 'gender x age' significant interaction, the means of the dataset plotted in Figures 3.13 and 3.14 indicates similar trends as the ones appeared earlier in section 3.2.1.2 (Figures 3.4 and 3.5) concerning the mean values difference of the raw F1 /e/-/ɛ/ and /o/-/ɔ/. In Figures 3.13 and 3.14, slightly divergent bars highlight small differences between females and males across age. In a similar vein, differences for each of the three age groups across gender can be noted. As shown earlier in section 3.2.1.2 (see Figures 3.4 and 3.5), Figure 3.13 also reveals that within the male group, the F1 difference for /e/-/ɛ/ increases progressively across age groups.

Similarly, within the female group, the F1 difference for /o/-/ɔ/ develops gradually across age groups, despite a less symmetrical incline observed between females of 35-54 and 55-75 years (see Figure 3.14).

b) The 'gender x language dominance' interaction, on the other hand, achieved significance regarding the /o/-/ɔ/ pair, [F(1,64) = 10.47, p = .0019], but not for /e/-/ɛ/ (see Figures 3.15 and 3.16).

According to the pairwise comparison tests, the significant effect for the /o/-/ɔ/ pair was associated with a larger difference for Catalan-dominant females than for Spanish-dominant females [F(1,64) = 16.75, p = .0001], unlike between Catalan-dominant and Spanish-dominant males no significant effect came out from their difference (see Figure 3.16). The same significant effect for the /o/-/ɔ/ pair of the raw F1 difference can be noticed in section 3.2.1.2 (see Figure 3.7). Moreover, as the same figure reveals in parallel with the results of the raw F1 dataset, pairwise comparisons also yielded a significant difference between Catalan-dominant speakers of different gender [F(1,64) = 7.54, p = .0078] in the sense that females performed better than males. The differences among Catalan-dominant males and both Spanish-dominant males and females, and between Spanish-dominant females and males, did not achieve any significance.

Figure 3.15 Mean of the normalised F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x language dominance

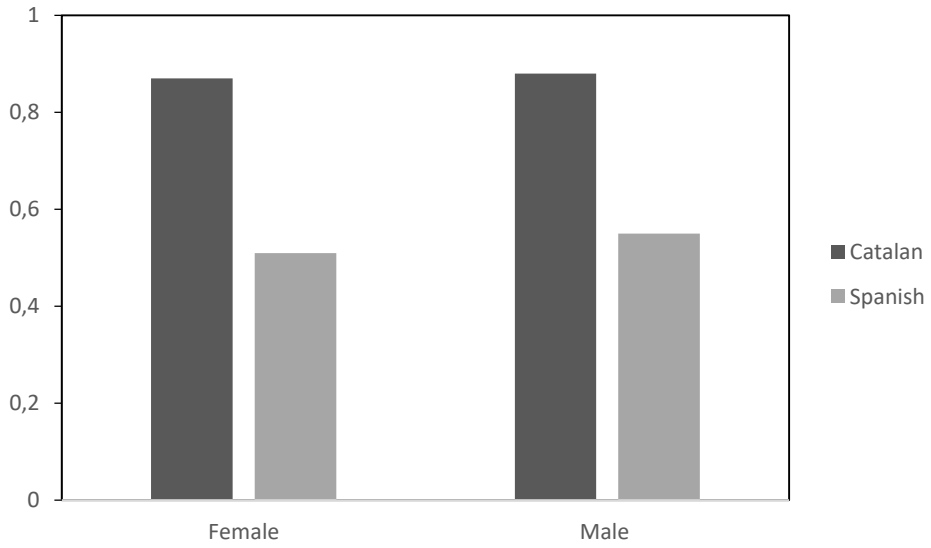
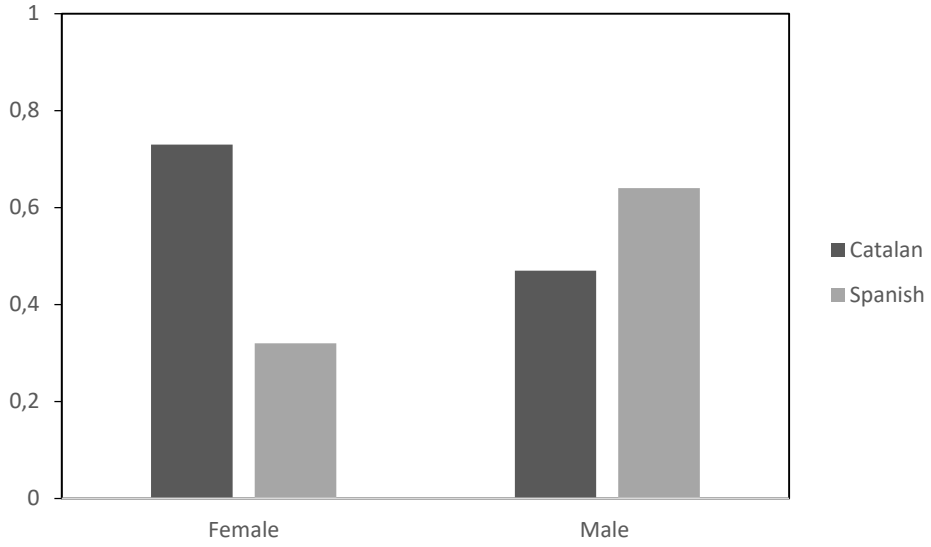


Figure 3.16 Mean of the normalised F1 differences for the vowel pair /o/-/ɔ/ conditioned by gender x language dominance



c) The interaction of 'age x language dominance' for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs was non-significant.

A number of trends were discussed earlier in section 3.2.1.2 (see Figures 3.8 and 3.9) about the raw F1 difference of the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs, which fully correspond to the present trends about the normalised F1 difference of the mid-vowel pairs highlighted in Figures 3.17 and 3.18. In this regard, a clear trend is shown by the Catalan-dominant bilinguals for displaying a greater acoustic distance between the vowels of the /e/-/ɛ/ and /o/-/ɔ/ pairs than the Spanish-dominant bilinguals across all age groups. Finally, regarding the Catalan-dominant group, the acoustic distance for the /o/-/ɔ/ vowel pair develops gradually across age groups; the older the speakers are, the better they perform.

3.17 Mean of the normalised F1 differences for the vowel pair /e/-/ɛ/ conditioned by age x language dominance

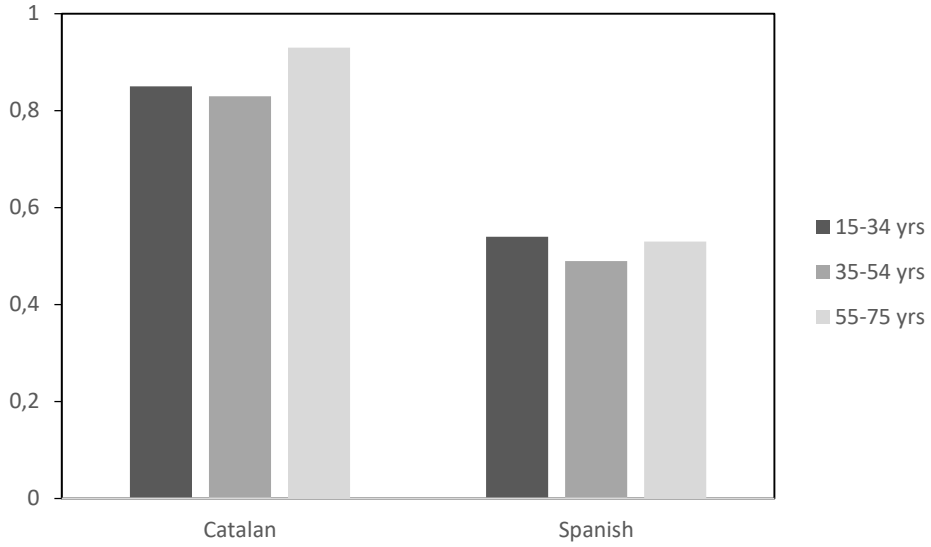
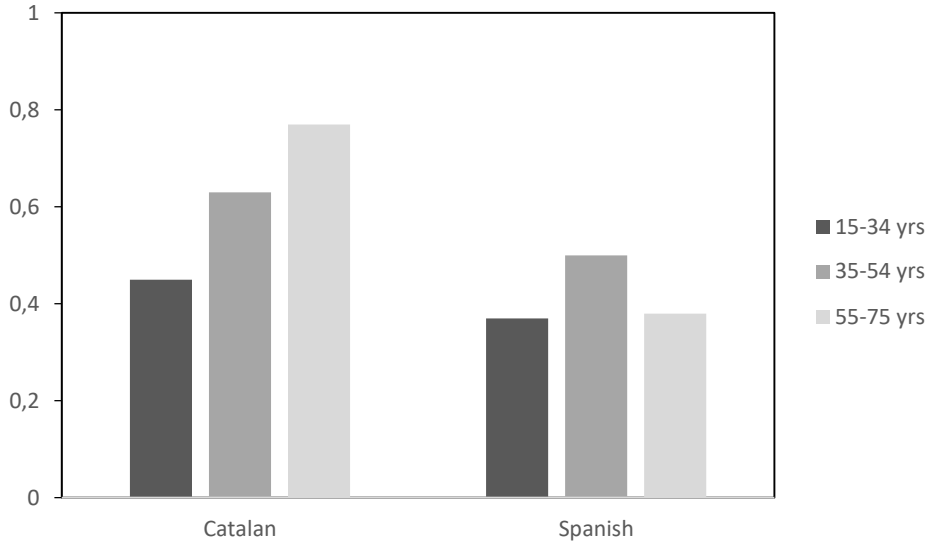


Figure 3.18 Mean of the normalised F1 differences for the vowel pair /o/-/ɔ/ conditioned by age x language dominance



3.2.3 Summary

Catalan/Spanish-dominant speakers were found to distinguish better between mid-front vowels than between mid-back vowels, while Catalan-dominant speakers provided more robust mid-vowel contrasts in the /e/-/ɛ/ and /o/-/ɔ/ productions than Spanish-dominant speakers. Among all three independent variables employed in the current experiment, language dominance is the single variable that leaded to a statistically significant main effect. Moreover, language dominance

steered gender towards significance, as it became evident from the gender and language dominance interaction. It should be also mentioned that age interplaying with language dominance demonstrated a number of clear trends discussed in this section, which however, seem to be obliterated during the process of statistical analysis.

Moving from the effect of language dominance to the effect of age, older speakers seemed to perform better in mid-vowel contrasts than younger speakers. A progressive upward trend, notably for /o/-/ɔ/, was indicated from younger to older speakers. In order to better describe all possible cases, it is necessary to consider the effect of age in relation to gender. More specifically, middle-aged and older females were found to perform better in the /o/-/ɔ/ use than youngsters and young females while, middle-aged and older males were found to perform better in the /e/-/ɛ/ use than youngsters and young males. A set of subsequent comparisons between a) older and middle-aged female groups, and b) older and middle-aged male groups, highlight a better /o/-/ɔ/ use by older than middle-aged female speakers and a better /e/-/ɛ/ use by older than middle-aged male speakers, respectively. A scale in the following order, from higher to lower mid-back vowel differences, becomes apparent for females: older females > middle-aged females > youngsters and young females. Another scale in the same order, from higher to lower mid-front vowel differences, becomes evident for males: older males > middle-aged > youngsters and young males.

Despite the effect of age was not apparently linked to language dominance, it seemed to have a greater impact on the /o/-/ɔ/ production of the Catalan-dominant group than the /o/-/ɔ/ production of the Spanish-dominant group. A scale in the following order, from higher to lower mid-back vowel differences, can better define a gradual decrease for /o/-/ɔ/ existing within the Catalan-dominat group: older adults > middle-aged adults > youngsters and young people.

Although female/male-dominant bilinguals seemed to produce systematically mean values differences close to one another, a meaningful pattern emerged from the effects of the gender and language dominance factors. Thus, Catalan-dominant females performed significantly better in /o/-/ɔ/ than Catalan-dominant males and Spanish-dominant females, while quite the opposite (males > females) was the case for the Spanish-dominant group.

3.3 Mother tongue (Catalan/Spanish-speaking parents)

Section 3.3 will present the statistical analyses results seeking to determine whether gender, age and mother tongue significantly affect the mid-front/back vowel contrasts. Statistical results are divided between raw and normalised F1 mean differences for /e/-/ɛ/ and /o/-/ɔ/, following the same logical grouping as in section 3.2. Thus, section 3.3.1 will deal with the raw F1 analysis results for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs, and section 3.3.2 with the normalised F1 analysis results for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs. The two sections will offer a short summary, which will allow us to briefly discuss the implications of the results of the mother tongue experiment in Chapter 4. A comparison between the mother tongue and language dominance experiments will be performed in section 3.4, from where the final conclusion can be drawn.

3.3.1 Raw F1 values

3.3.1.1 Main effects

The statistical analysis yielded no main effect of both gender and age either for the raw F1 values of the /e/-/ɛ/ pair, or for the raw F1 values of the /o/-/ɔ/ pair. Such an absence of main effects, confirmed, when taken as a whole, that female/male speakers as well as speakers of different age groups were not producing /e/-/ɛ/ and /o/-/ɔ/ significantly different. The results of gender and age shown in Figures 3.19 and 3.20 corroborate that these independent variables exert statistically non-significant effects on the /e/-/ɛ/ and /o/-/ɔ/ vowel contrasts.

Figure 3.19 Mean of the raw F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by gender

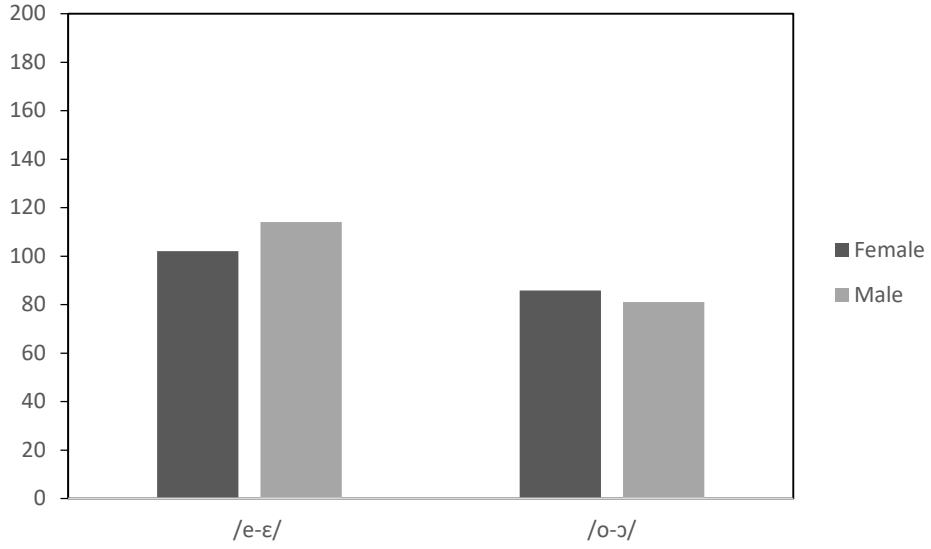
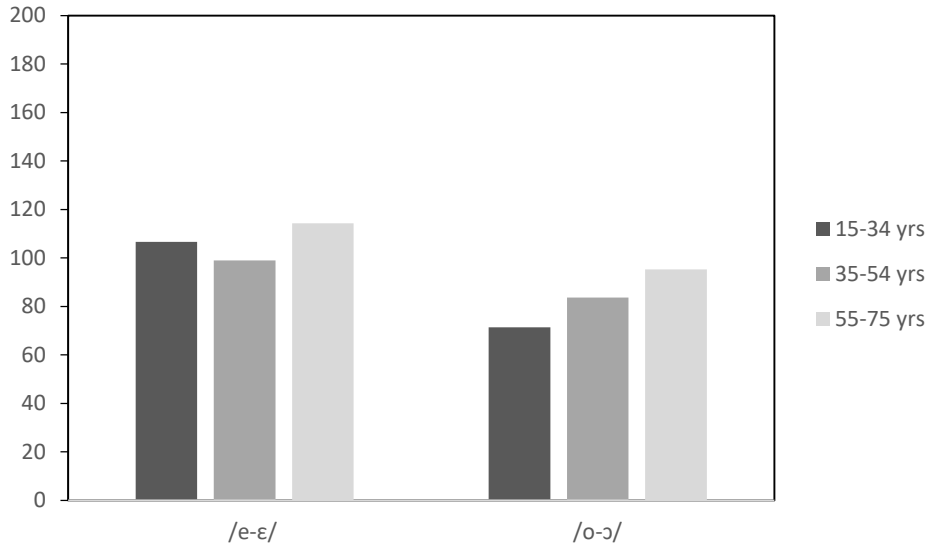


Figure 3.20 Mean of the raw F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by age

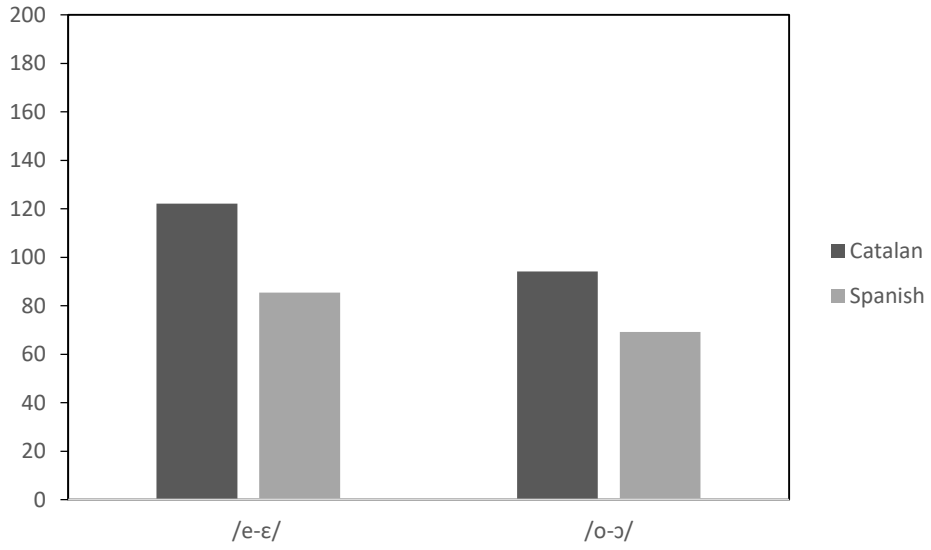


While age has been marked as non-significant, in-depth, age-grading differences reveal that all age groups display a higher F1 difference for /e/-/ɛ/ than for /o/-/ɔ/. Moreover, a sharp F1 difference can be noticed between youngsters and young people (15-34 years), with a higher /e/-/ɛ/ than an /o/-/ɔ/ difference. Similarly, the middle-aged adults group (35-54 years) displays a higher F1 mean difference for /e/-/ɛ/ than for /o/-/ɔ/. With respect to the older adults group (55-75 years), a mean difference of F1 /e/-/ɛ/ values higher than the mean difference of F1 /o/-/ɔ/ values can also be observed. Overall, as highlighted in Figures 3.19 and 3.20, both two gender groups, as well as all

three age groups, show a greater acoustic distance between the /e/-/ɛ/ than the /o/-/ɔ/ vowel contrasts.

In contrast, there was a barely significant main effect of mother tongue for the mid-back vowel contrast [F(1,51) = 4.10, p. = .0481], but not for the mid-front vowel contrast. In Figure 3.21 the significant effect of mother tongue is witnessed; the group whose parents are both Catalan-speakers display a greater F1 mean distance between /e/-/ɛ/ and between /o/-/ɔ/ than the group whose parents are both Spanish speakers. It should be recalled that groups whose parents are Catalan/Spanish speakers have been simply named as Catalan/Spanish speakers groups. In addition, all speakers (Catalan, Spanish) show a clear trend for a larger acoustic distance between the vowels of the /e/-/ɛ/ pair than vowels of the /o/-/ɔ/ pair.

Figure 3.21 Mean of the raw F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by mother tongue



3.3.1.2 Interactions

In order to gain a better insight into how the effect of one independent variable depends on the effect of another independent variable, results for the 'gender x age', 'gender x mother tongue' and 'age x mother tongue' interactions will be enumerated in a), b) and c).

a) No significant interaction was obtained between gender and age either for /e/-/ɛ/ or for /o/-/ɔ/.

Figure 3.22 Mean of the raw F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x age

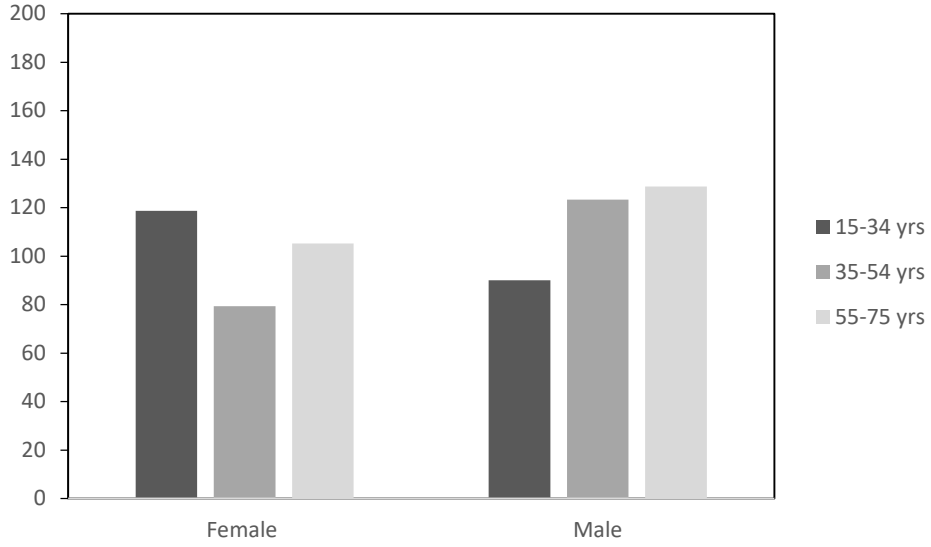
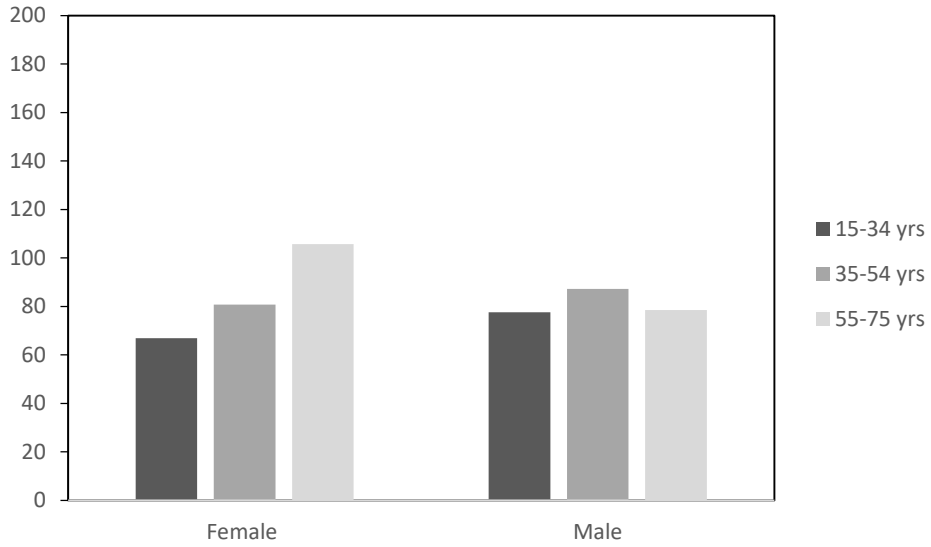


Figure 3.23 Mean of the raw F1 difference for the vowel pair /o/-/ɔ/ conditioned by gender x age



Despite the 'gender x age' interaction yielded non-significant effects, the means of the dataset plotted in Figures 3.22 and 3.23 show a number of interesting trends. In Figure 3.22, a tendency is revealed for females of 15-34 years to perform better in /e/-/ɛ/ than males. In the case of the /o/-/ɔ/ vowel pair on the other hand, the prevailing tendency is for males of 15-34 years to perform faintly better than females. A divergent trend arises by considering the mid-vowel pairs of females/males of 35-54 years, as illustrated in both Figures 3.22 and 3.23. Particularly, the female group of 35-54 years has a distinctively lower F1 difference for /e/-/ɛ/ and a scarcely lower F1 difference for

/o/-/ɔ/ than the male group of the same age. Based on the findings for the /e/-/ɛ/ vowel pair of the 55-75 age group, males perform slightly better than females. Conversely, in the case of the /o/-/ɔ/ vowel pair, the predominant tendency is for females of 55-75 years to perform better than males.

When the effect of age within each gender condition is taken into account, a gradually developed increase of the F1 difference for /o/-/ɔ/ can be seen in Figure 3.23 in females from 15 to 75 years. Similarly, a noticeably less symmetrical incline of the F1 difference for /e/-/ɛ/ can be seen in Figure 3.22 in males from 15 to 75 years. From the perspective of further exploring trends within each gender group, the acoustic distance between the /e/-/ɛ/ vowel pair is greater for the female age groups of 15-34 and 55-75 years than for the female age group of 35-54 years. Within the male group, the /o/-/ɔ/ vowel pair shows barely identical means of F1 difference concerning the 15-34 and 55-75 age groups, unlike the group of 35-54 years, who display a slightly higher F1 mean difference.

b) The 'gender x mother tongue' interaction, on the other hand, achieved significance regarding the /o/-/ɔ/ pair, [$F(1,50) = 8.33$, $p = .0057$], but not for the /e/-/ɛ/ pair.

Pairwise comparison tests run yielded a significant difference between Catalan and Spanish female speakers [$F(1,50) = 12.37$, $p = .0009$], unlike between Catalan and Spanish male speakers no significant effect came out from their difference (see Figure 3.25). As regards male speakers, they followed the opposite trend, with Spanish males presenting a higher F1 difference for /o/-/ɔ/ than Catalan males. Furthermore, as the same figure reveals, pairwise comparisons also yielded a significant difference between Catalan speakers of different gender [$F(1,50) = 4.56$, $p = .0376$] in the sense that females performed better than males. Despite the difference between Spanish-speaking females and males was close to ascertain significance [$F(1,50) = 3.98$, $p = .0515$] did not achieve any. In the latter case, differently from the Catalan speakers group, males made a better distinction between the vowels of the /o/-/ɔ/ pair than females.

Figure 3.24 Mean of the raw F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x mother tongue

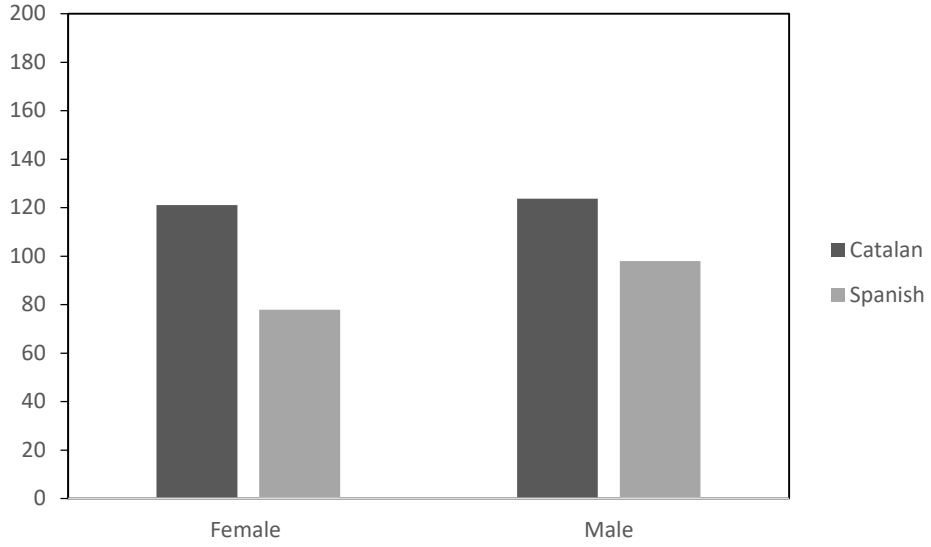
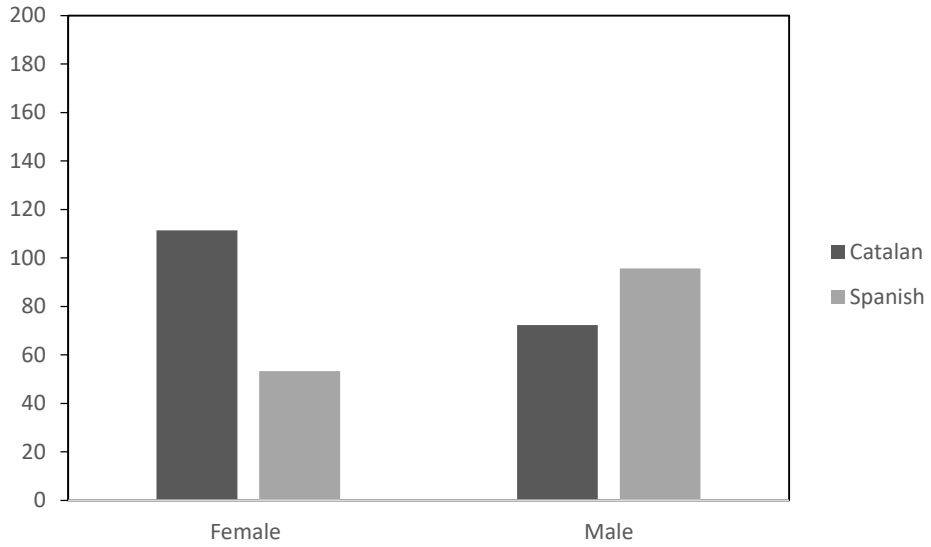


Figure 3.25 Mean of the raw F1 differences for the vowel pair /o/-/ɔ/ conditioned by gender x mother tongue



Figures 3.24 and 3.25 highlight the relative importance of trends, as these arise from the 'gender x mother tongue' interaction. A non-existent difference for /e/-/ɛ/ between the means of the females and males speakers of the Catalan group, along with a more obvious difference for /e/-/ɛ/ between the means of the female and male speakers of the Spanish group, are reported in Figure 3.24. In both cases, males perform better in /e/-/ɛ/ than females. By way of contrast, Catalan-speaking females perform better in /o/-/ɔ/ than Catalan-speaking males, while the opposite trend is revealed for /o/-/ɔ/, regarding the Spanish-speaking female/male group. In addition, a quite

divergent trend of mother tongue across gender is observed in Figures 3.24 and 3.25. Specifically, the acoustic distance between both /e/-/ɛ/ and /o/-/ɔ/ is larger for female Catalan speakers than for female Spanish speakers. In the male group, whilst Catalan speakers exhibit a higher F1 /e/-/ɛ/ difference than Spanish speakers, their F1 difference for /o/-/ɔ/ is distinctly lower in comparison to Spanish speakers.

c) The interaction of 'age x mother tongue' for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs was non-significant.

Figure 3.26 Mean of the raw F1 differences for the vowel pair /e/-/ɛ/ conditioned by age x mother tongue

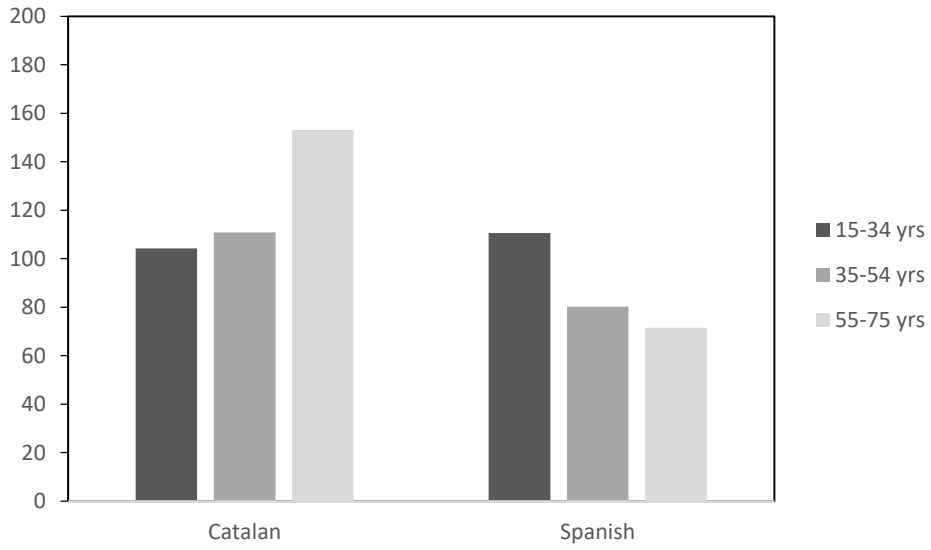
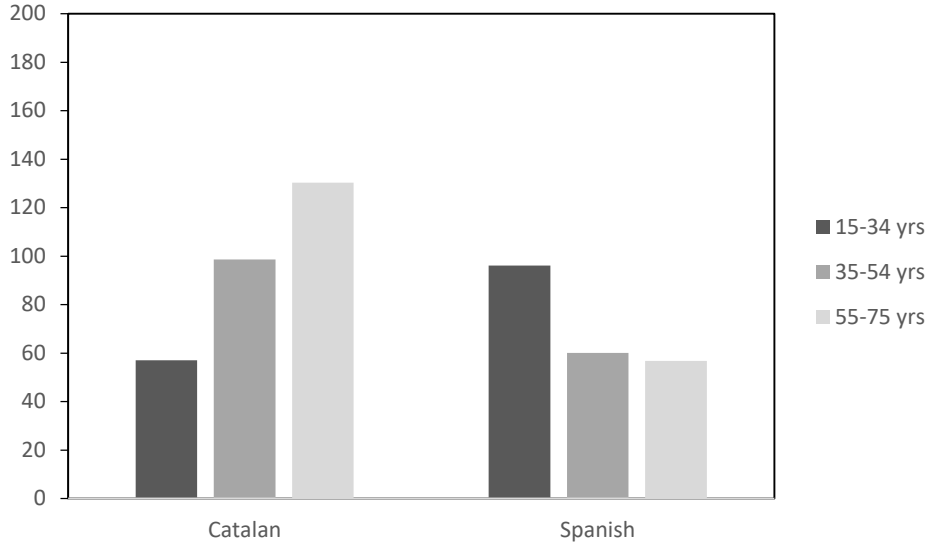


Figure 3.27 Mean of the raw F1 differences for the vowel pair /o/-/ɔ/ conditioned by age x mother tongue



Figures 3.26 and 3.27 show several appealing trends in 'age x language dominance'. Predominantly, the acoustic distance between the vowels of the /e/-/ɛ/ and /o/-/ɔ/ pairs is greater for Catalan speakers than for Spanish speakers across all age groups. A couple of well-formed patterns showing upwards and downwards trends are manifested in Figures 3.26 and 3.27. Particularly, within the Catalan speakers group, the acoustic distance for both /e/-/ɛ/ and /o/-/ɔ/, grows larger across age groups. The older Catalan speakers are, the better they perform in the mid-vowel contrasts. In contrast, within the Spanish speakers group, the acoustic distance for both /e/-/ɛ/ and /o/-/ɔ/, grows smaller across age groups. The younger Spanish speakers are, the better they perform in the mid-vowel contrasts.

3.3.2 Normalised F1 values

3.3.2.1 Main effects

The statistical analysis yielded no main effect of gender and age either for the normalised F1 values for /e/-/ɛ/, or for the normalised F1 values for /o/-ɔ/. Figure 3.28 depicts that regarding the mean differences for /e/-/ɛ/ and /o/-/ɔ/, males perform distinctly better in /e/-/ɛ/ than females and marginally better in /o/-/ɔ/. In addition, Figure 3.29 illustrates similarities of F1 difference for /e/-/ɛ/ across age groups. Specifically, examining the F1 mean differences across age groups, the group of youngsters and young people barely overlaps with the group of older adults. Nevertheless, the latter group presents a faintly higher F1 /e/-/ɛ/ difference than the middle-aged and youngsters

and young people groups. In terms of the F1 differences for /o/-/ɔ/, they are barely identical for the middle-aged adults and older adults, while slightly lower for youngsters and young people. Taking different gender/age groups into consideration, the normalised F1 differences are consistent with the raw F1 differences presented previously in section 3.3.1.1. One, possible trivial inconsistency, have been observed; the raw F1 difference for /o/-/ɔ/ is higher in females than males, whilst the normalised F1 difference for /o/-/ɔ/ shows that males perform vaguely better than females. Moreover, both raw and normalised F1 differences corroborate that the acoustic distance is steadily higher for /e/-/ɛ/ than for /o/-/ɔ/.

Figure 3.28 Mean of the normalised F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by gender

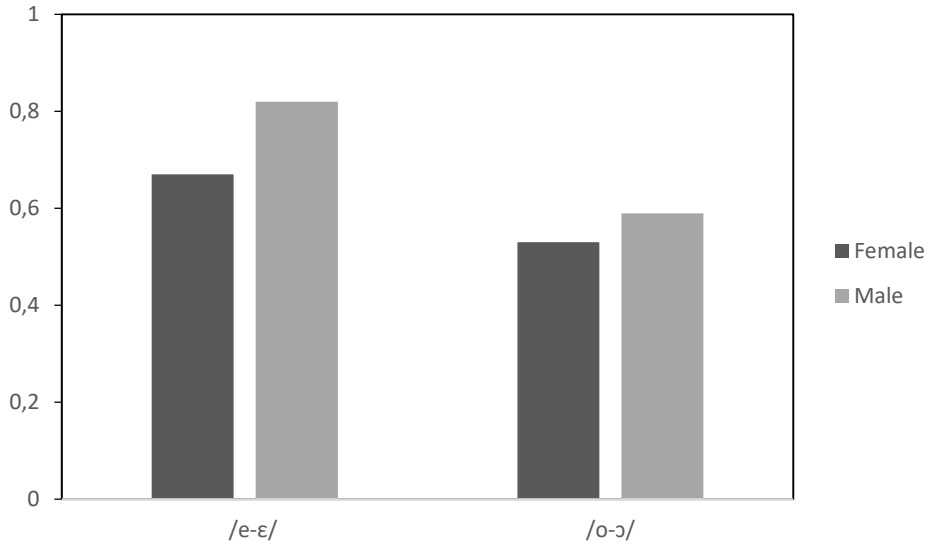
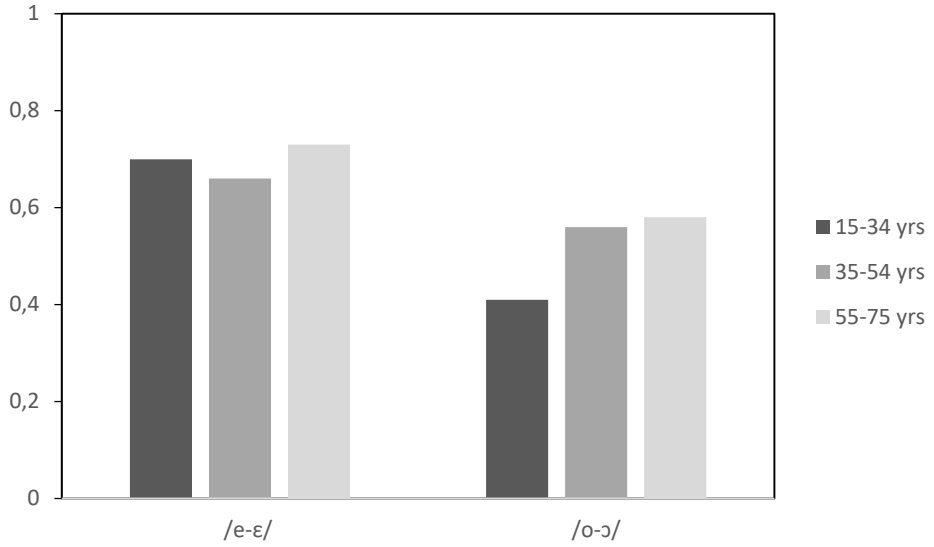
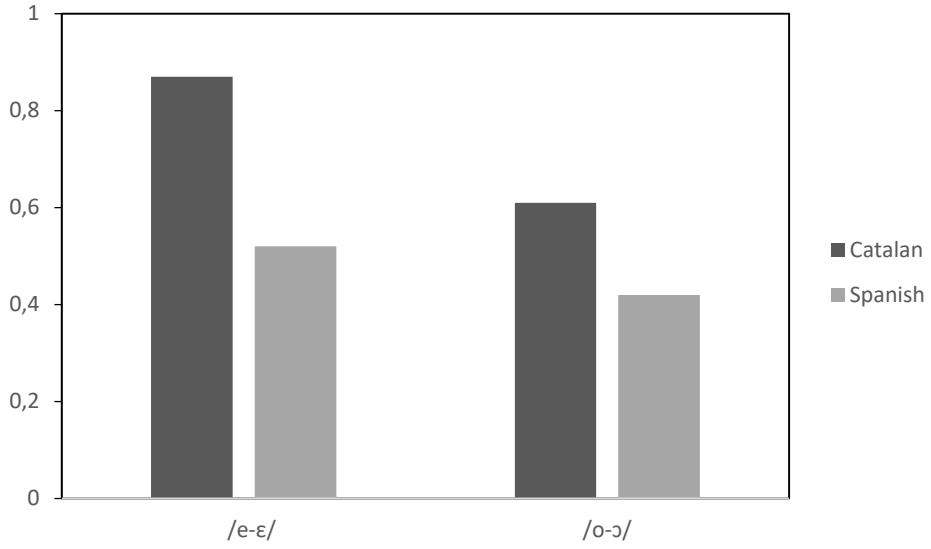


Figure 3.29 Mean of the normalised F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by age



The statistical results supported the finding of a main effect of mother tongue for /e/-/ɛ/ [F(1,53) = 5.20, p = .0266], but not for /o/-/ɔ/. Nevertheless, in the case of the raw F1 values (see section 3.2.3.1) the difference between the vowels of the mid-back pair achieved significance, unlike the vowels of the mid-front one. Figure 3.30 presents the main effect of mother tongue. It particularly reports a larger gap between the mean of the F1 /e/-/ɛ/ difference conditioned by Catalan speakers, in comparison to that of the F1 /e/-/ɛ/ mean, difference conditioned by Spanish speakers. Nevertheless, the gap is narrower between the F1 /o/-/ɔ/ mean difference of the Catalan-speaking group and the F1 /o/-/ɔ/ mean difference of the Spanish-speaking group. In general terms, both the normalised and raw F1 differences, indicate a clear trend for a greater acoustic distance between the vowels of the /e/-/ɛ/ pair than for the vowels of the /o/-/ɔ/ pair across mother tongue conditions.

Figure 3.30 Mean of the normalised F1 differences for the vowel pairs /e/-/ɛ/ and /o/-/ɔ/ conditioned by mother tongue



3.3.2.2 Interactions

a) A non-significant interaction was obtained between gender and age either for /e/-/ɛ/ or for /o/-/ɔ/, as illustrated in Figures 3.31 and 3.32.

Figure 3.31 Mean of the normalised F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x age

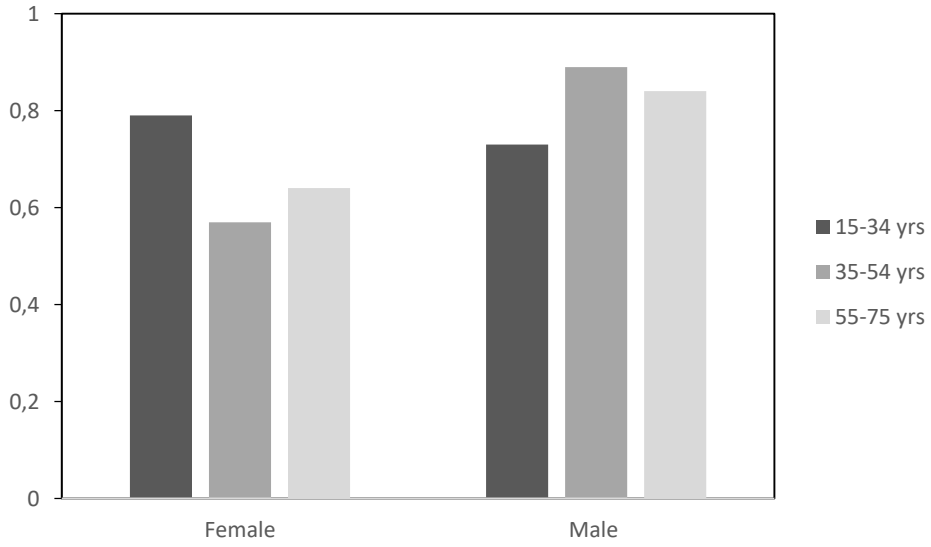
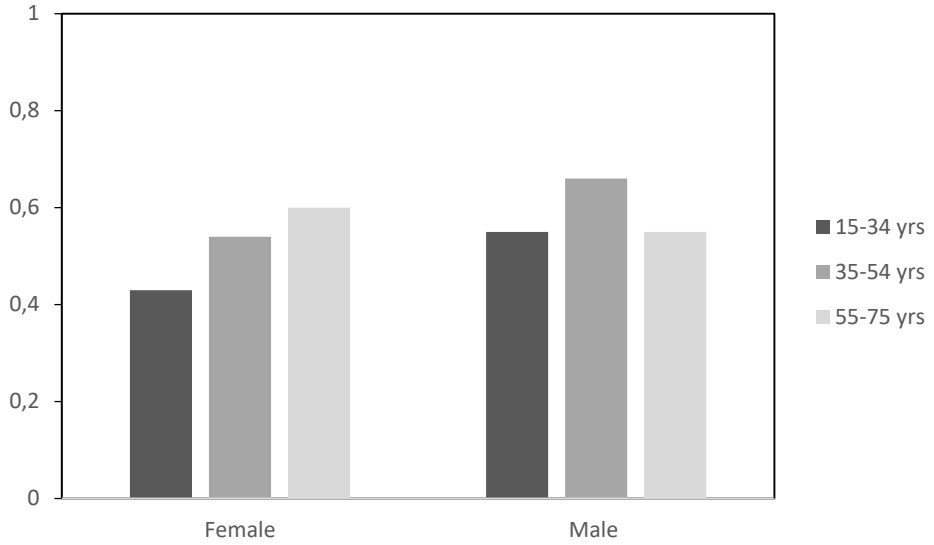


Figure 3.32 Mean of the normalised F1 difference for the vowel pair /o/-/ɔ/ conditioned by gender x age



Besides the absence of a 'gender x age' significant interaction, the means of the dataset plotted in Figures 3.31 and 3.32 show almost identical trends to the ones appeared earlier in section 3.3.1.2 (Figures 3.22 and 3.23) regarding the mean of the raw F1 difference either for /e/-/ɛ/ or for /o/-/ɔ/. As a noticeably degree of similarity between the normalised and raw F1 differences appears to prevail, it should be only worth-mentioning that, the F1 /e/-/ɛ/ difference is slightly higher in males of 35-54 years than in males of 55-75 years, unlike the small incline of the F1 difference for /e/-/ɛ/ previously observed in males across age groups (see Figure 3.22).

b) The 'gender x mother tongue' interaction, on the other hand, achieved significance regarding the /o/-/ɔ/ pair, [$F(1,50) = 5.03$, $p = .0293$], but not for /e/-/ɛ/ (see Figures 3.33 and 3.34).

Pairwise comparison tests run yielded a significant difference between Catalan and Spanish female speakers [$F(1,50) = 5.14$, $p = .0277$], unlike between Catalan and Spanish male speakers no significant effect came out from their difference (see Figure 3.34). Nevertheless, as the same figure reveals, pairwise comparisons did not yield any significant difference between Catalan speakers of different gender, unlike the significant effect for the /o/-/ɔ/ pair of the raw F1 difference, previously reported in section 3.3.1.2 (see Figure 3.25). In addition, despite the difference between Spanish speakers of different gender was close to ascertain significance [$F(1,50) = 3.98$, $p = .0514$],

did not achieve any. In the latter case, in parallel with the raw F1/o/-/ɔ/ difference, males made a better distinction between the vowels of the /o/-/ɔ/ pair than females.

Figure 3.33 Mean of the normalised F1 differences for the vowel pair /e/-/ɛ/ conditioned by gender x mother tongue

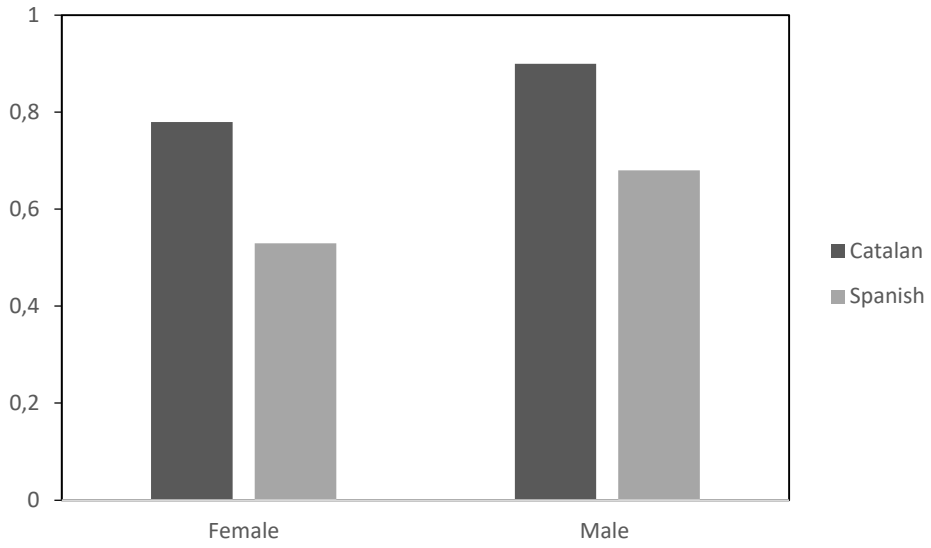
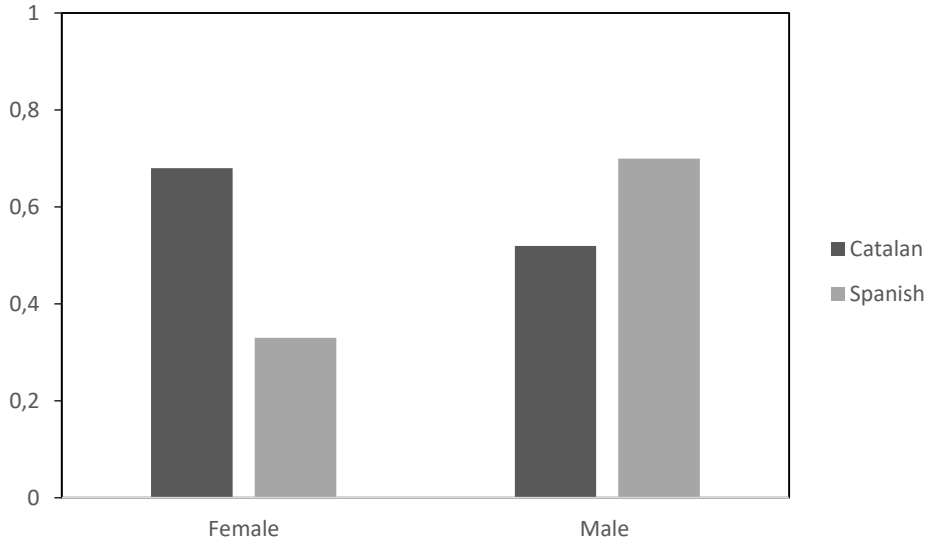


Figure 3.34 Mean of the normalised F1 differences for the vowel pair /o/-/ɔ/ conditioned by gender x mother tongue



c) The interaction of 'age x mother tongue' for the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs was non-significant.

A number of trends, as discussed earlier in section 3.3.1.2 (see Figures 3.26 and 3.27) about the raw F1 difference of the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs, fully correspond to the present trends about

the normalised F1 difference of the mid-vowel pairs. In short, the F1 difference of Spanish speakers for both /e/-/ɛ/ and /o/-/ɔ/ shows a gradually downward trend across age groups, while in the Catalan speakers group, the acoustic distance for both the /e/-/ɛ/ and /o/-/ɔ/ vowel pairs shows a gradually upward trend across age groups.

Figure 3.35 Mean of the normalised F1 differences for the vowel pair /e/-/ɛ/ conditioned by age x mother tongue

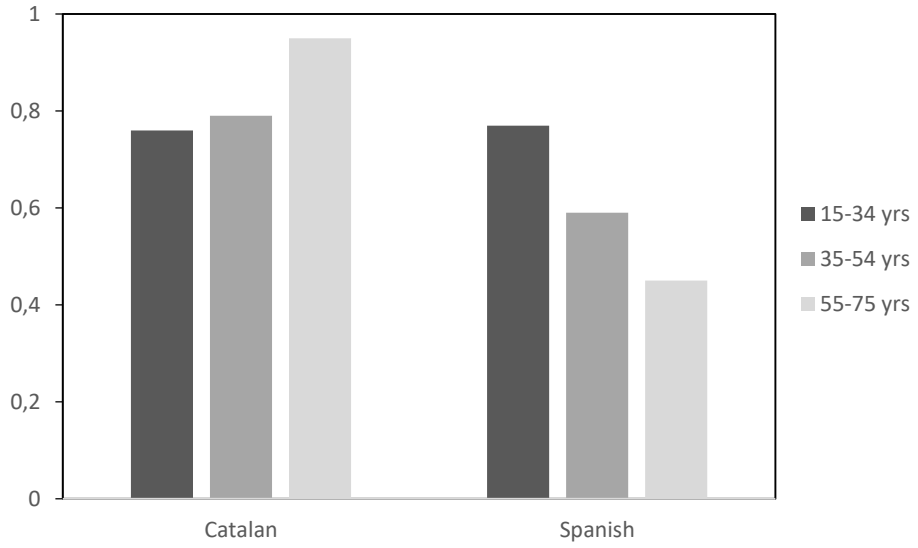
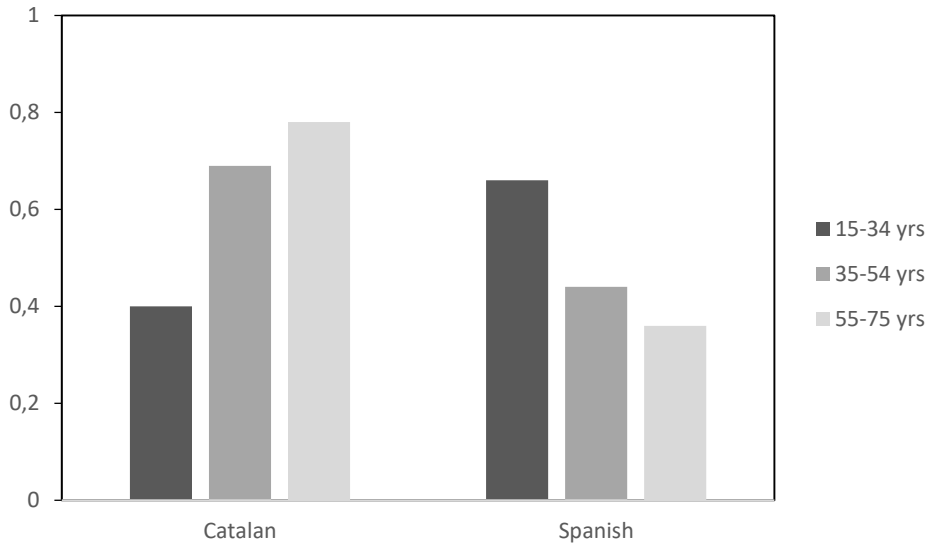


Figure 3.36 Mean of the normalised F1 differences for the vowel pair /o/-/ɔ/ conditioned by age x mother tongue



3.3.3 Summary

Individuals with Catalan/Spanish speaking parents were found to make a better distinction between mid-front vowels than between mid-back vowels, while individuals whose parents were Catalans provided more robust mid-vowel contrasts in the /e/-/ɛ/ and /o/-/ɔ/ productions than those whose parents were Spanish. Among all three independent variables used in the present experiment, mother tongue is the single variable that yielded a statistical main effect. In addition, the gender and mother tongue interaction turned out to be significant due to the involvement of the mother tongue in this correlation. It should be also mentioned that age interplaying with mother tongue showed several trends this section summarises, which yet again, seem to be obliterated during the process of statistical analysis.

From the perspective of the age effect, age-grading differences highlight that all age groups perform better in /e/-/ɛ/ than in /o/-/ɔ/. In order to account for these cases in a more specific way, it is necessary to consider the effect of age in relation to gender. Thus, youngsters and young females were found to perform better in the /e/-/ɛ/ use than middle-aged and older females while, middle-aged and older males were found to perform better in the /e/-/ɛ/ use than youngsters and young males. A scale established in the following order, from higher to lower acoustic distances, sheds light on the case of females: youngsters and young females > middle-aged and older females. Another scale, following the same order, is apparent for males: middle-aged and older males > youngsters and young males. In addition, older females seemed to be the ones than made a better distinction between /o/-/ɔ/ than middle-aged, youngsters and young females. These findings seem to become evident from the higher to the lower acoustic distance between mid-back vowels, in the following scale: older females > middle-aged females > youngsters and young females. Whilst, the youngsters/young and older males presented very similar /o/-/ɔ/ differences in their productions, the mid-back vowel productions of the middle-aged males were superior to the other age groups. Despite the strength of this effect is weak, a scale emerges from higher to lower for males as follows: middle-aged males > youngster, young and older males.

A general pattern came out from the effects of the gender and mother tongue factors. Catalan/Spanish-speaking males distinguished better between /e/-/ɛ/ than Catalan/Spanish-speaking females, which allows us to provide a simplified scale, from the higher to the lower

acoustic distance between mid-front vowels, as follows: males > females. Catalan-speaking females seemed to be better users of the mid-back vowel pair than Catalan-speaking males and Spanish-speaking females, but not than Spanish-speaking males. A single simplified scale from higher to lower for /o/-/ɔ/ would rather not be enough for the previous statement to be supported. Thus, two scales established in the same order arise as follows: Catalan females > Spanish females and Catalan males; Spanish males > Catalan males and Spanish females.

Despite the effect of age was not strongly tied to mother tongue, it seemed to have a reversed impact on the mid-front and mid-back vowel productions of Catalan speakers than those of Spanish speakers. A scale in the following order, from the higher to the lower acoustic distance between mid-vowels, best accounts for a gradual decrease across age in the Catalan-speaking group: older adults > middle-aged adults > youngsters and young people. Finally, the same scale, fully determines a gradual decrease across age in the Spanish-speaking group: youngsters and young people > middle-aged adults > older adults.

3.4 General summary

In general terms, Catalan-dominants and speakers whose parents were both Catalans produced mid-vowel contrasts more robustly than Spanish-dominants and speakers whose parents were both Spanish. All speakers, across gender, age, language dominance, mother tongue and each factor patterned with another, were found to provide a better distinction between mid-front vowels than between mid-back vowels. Only Spanish-dominant males did not seem to share this trend as they performed slightly better in mid-back vowels than in mid-front ones (Figures 3.6 and 3.7). Moreover, as a general rule, in both language dominance and mother tongue experiments, the older the speakers are, the better mid-back vowel contrast is retained (Figures 3.2, 3.11, 3.20 and 3.29).

In the light of the findings of the language dominance experiment, two, albeit non-significant, uniformly distributed patterns, have emerged from the gender and age factors. The mid-front vowel contrast is progressively better preserved by older generation male speakers (older males > middle-aged males > youngsters and young males). The mid-back vowel contrast, is progressively better retained by older generation female speakers (older females > middle-aged females > youngsters and young females). Similarly, in the case of the mother tongue experiment, it can be viewed that

the mid-back vowel contrast is gradually better retained by older generation female speakers (older females > middle-aged females > youngsters and young females).

On account of the overall gender and language dominance/mother tongue interaction, it can be noticed that the mid-back vowel contrast is clearly better produced by Catalan females than Catalan males (females > males), as highlighted in Figures 3.7, 3.16, 3.25 and 3.34 and further supported by the significant statistical results; by contrast, in the Spanish bilingual group, Spanish males can more robustly distinguish between /o/-/ɔ/ than Spanish females (males > females), as illustrated in the same figures indicated above. On the other hand, Catalan females exhibit a better mid-back vowel differentiation than Spanish females (Catalan females > Spanish females). However, regarding males, the reverse trend was found; Spanish males display a better mid-back vowel differentiation than Catalan males (Spanish males > Catalan males). Apart from these differences, the only ones which reached significance are those related to Catalan females (Catalan females > Catalan males, Spanish females). Nevertheless, a number of outcomes for /e/-/ɛ/, though non-significant, are clearly in favour of the Catalan bilingual group. There seems to be apparent that Catalan females' production is more successful than Spanish females' production, as shown in Figures 3.6, 3.15, 3.24 and 3.33, alongside the fact that Catalan males have a better mid-front vowel distinction than Spanish males.

Furthermore, the mother tongue experiment gives rise to an appealing, but non-significant finding. Age patterned with mother tongue exclusively provides a tendency revealing that the youngster the Spanish group is, the better mid-vowel contrasts are preserved (see Figures 3.26 and 3.27). Nevertheless, evidence based on the same Figures, points out an opposite trend for Catalan speakers, according to which the older the Catalan group is, the better mid-vowel contrasts are retained. The latter trend also conforms to evidence documented in the age and language dominance interaction for the Catalan-dominant speakers but not for the Spanish-dominant speakers (Figures 3.9 and 3.18).

In sum, a particular issue that should be elaborated in Discussion is that a uniform pattern has arisen from the gender and age factors. Males' mid-front vowel differentiation becomes more robust with age, while females' mid-back vowel differentiation becomes better across age groups.

Moreover, there is a broad link between the gender and mother tongue factors consistent to the gender and language dominance factors to the extent that the mid-back vowel contrast is by far better attained by Catalan-dominant and Catalan-speaking females. In this regard, an attempt should be made to best account particularly for the mid-back vowel pair and its relationship to 'gender x language dominance' and 'gender x mother tongue', as it has significantly impacted the results. Finally, particular attention should be paid on the two different patterns that have emerged from the age and mother tongue factors, according to which, school instruction delivered in Catalan apparently enhances young Spanish speakers' performance in Catalan, but not young Catalan speakers' performance. Ultimately, it should be explained at length why the following trend respecting mid-vowels (Spanish youngsters and young people > Spanish middle-aged adults > Spanish older adults), is not reciprocal to the 'age x language dominance' experiment results.

Chapter 4

4. Discussion

This chapter will use the findings of the experiments given in Chapter 3 to show that an analysis of phonological variation in the given language contact situation can offer a sophisticated approach concerned with the effects of social factors on speech production. In section 4.1, the main findings of a series of experiments on the mid-vowel production in Central Catalan spoken in Barcelona will be summarised. Reviewing the experiment results will help to provide certain final conclusions to the thesis on the basis of reporting that the language dominance and mother tongue influence is enhanced by the same combination of social factors. As a number of hypotheses has been clearly presented at the end of the first chapter, it accords well with the aim to address them in section 4.2. In addition, in the same section, the extent to which hypotheses have been highly predictable or not, confirmed or dismissed, will be evaluated by the outcomes achieved in the present thesis project.

By taking a holistic approach to differences between mean formant frequency values which reflect the way phonetic and phonological properties of a number of lexical items are produced by Catalan/Spanish bilinguals, this research will demonstrate whether vowel contrasts, near-mergers and mergers occur. Section 4.2 will also discuss the issues of attainment and change found in the relations of the Catalan stressed mid-vowels, split in two parts 4.2.1, discussing the initial hypotheses check and 4.2.2, presenting the findings beyond the scope of this thesis project. Ultimately, what I will intend to make clear in section 4.3, is that this experimental work indeed promotes our understanding of language variation and contact-induced processes. The language dominance and mother experiments, after statistical analysis was employed, demonstrated that language variation is externally induced. This type of language variation is underlined by the presence of single significant factors (language dominance and mother tongue), significant interactions between factors (gender and language dominance and gender and mother tongue) and finally some clear trends found in the data. Nevertheless, some of the factors cannot guarantee any bearing on the achieved outcomes as the results either lack statistical significance, or no clear data trends have been identified.

4.1 Summary of the major findings

The experiments reported in Chapter 3 gave rise to the following broad findings connected with significance or not:

- The group of Catalan bilinguals displays a greater F1 mean distance between /e/-/ɛ/ and between /o/-/ɔ/ than the group of Spanish bilinguals, who demonstrates a greater number of near-mergers and mergers (significant).
- Overall, mid-front vowels were better differentiated than mid-back vowels at a production level (non-significant).
- As a general rule, the older the speakers (Catalan, Spanish) are, the better the mid-back vowel contrast is retained. However, youngsters and young Spanish speakers, whose parents are both Spanish, perform better than middle-aged and older Spanish speakers. Conversely, middle-aged and older Catalan speakers, whose parents are both Catalans, exhibit a better mid-back differentiation than youngsters and young Catalan speakers (non-significant).
- The behaviour of females and males in the speech community under study is complementary regarding the mid-front/mid-back vowel distinction. The older the males are, the better they preserve the mid-front vowel contrast, while, the older the females are, the better they retain the mid-back vowel contrast (non-significant).
- The mid-back vowel pair turned out to be far better attained by Catalan-dominant and Catalan-speaking females (significant).

It would be interesting to provide a reasonable explanation for the broad similarities observed in single effects of variables as well as in the correlation between certain social factors regarding the production of specific vowel pairs. I should argue that what becomes obvious from both experiment results, given the lack of a significant difference in gender and age in performance, is that all gender groups on the one hand, and all age groups on the other hand, exhibit the same language competence in Catalan, as they produce mid-vowels in the same way. In order to explain language variation, it is important, to interpret the gender and age through their interaction with language dominance and mother tongue. These variables attribute different levels of competence to gender and age, especially for the mid-back vowel pair.

There seems to be apparent that the mid-back vowel difference is both gender-and language dominance-marked as well as both gender-and mother tongue-marked. The way, thus, the gender and language dominance factors, as well as the gender and mother tongue factors, interplay with each other, specifically for /o/-/ɔ/, has significantly impacted the results. Out of any interactional context, the effects of language dominance and mother tongue, respectively, have noticeably influenced the results as the importance of language dominance (Catalan) and L1 acquisition (Catalan) was highlighted in various instances of mid-vowel production, where solely /e/-/ɛ/ or /o/-/ɔ/, or both /e/-/ɛ/ and /o/-/ɔ/ are involved.

4.2 Hypotheses and current trends

4.2.1 Assessing initial hypotheses

In section 4.2.1 I intend to summarise the initial hypotheses formulated at the end of the first chapter, which, based on the results, can be either: a) fully confirmed or fully dismissed, or b) merely confirmed/dismissed.

In section 1.5, I have suggested that when looking at the mid-vowel production across bilingual groups, with Catalan-dominants/Catalan speakers on the one hand, and Spanish-dominants/Spanish speakers on the other, the use of near-mergers and mergers would be best seen in the Spanish bilingual group. A focus on the use of /e/-/ɛ/ and /o/-/ɔ/ seems to accord with a great deal of smaller F1 differences found in the language performance of the Spanish bilingual group. In addition, significant effects of language dominance and mother tongue have been witnessed and examplified in a series of figures illustrated in sections 3.2.1.1, 3.2.2.1, 3.3.2.1 and 3.3.2.2. **Overall, these findings have supported the hypothesis that the group of Catalan bilinguals displays a greater F1 mean distance between /e/-/ɛ/ and between /o/-/ɔ/ than the group of Spanish bilinguals. In addition, the same hypothesis, on the basis of the prediction that more instances of near-mergers and mergers between /e/-/ɛ/ and /o/-/ɔ/ would be identified in the speech of Spanish than in that of Catalan bilinguals, is confirmed by Table 3.1 (see section 3.1).**

The outcomes based on Table 3.1 have suggested that Catalan bilinguals exhibit fewer near-mergers and mergers instances (3) than Spanish bilinguals, whose number in near-mergers and

mergers is outstandingly greater (14). The same table also illustrates that the Spanish bilingual group contains 14 subjects producing near-mergers and mergers, 14 subjects producing vowel contrasts and 8 subjects who either retained the mid-front or the mid-back vowel contrast. Note that the Spanish bilingual group provides highly balanced results, as the same number of subjects producing vowel contrasts perfectly corresponds to the number of subjects producing near-mergers and mergers. What can be deduced from this observation is that the statistical analysis results steered the Spanish bilingual group towards vowel contrasts, when their means were aggregated and used in order to represent each F1 mean score of /e/-/ɛ/ and /o/-/ɔ/differences. It would be fair though to conclude that, the number of Spanish bilinguals producing near-mergers and mergers is significantly higher to those of the Catalan dominant group, which finally reiterates the fact that the whole hypothesis is confirmed.

In both experiments, non-significant differences have been provided for the F1 /e/-/ɛ/ and /o/-/ɔ/ means of Catalan bilinguals from 15 to 75 years. **These statistical results, apparently do not support the set of hypotheses formulated in section 1.5, whereby Catalan-dominant and Catalan speakers have been expected to behave similarly across age groups.** In fact, the older group of Catalan bilinguals outperforms the other two age groups. **The hypothesis that youngsters and young Spanish bilinguals perform better than middle-aged and older Spanish bilinguals is merely supported by the following actual trend.** A higher degree of F1 mid-vowel differentiation has been attested exclusively in the speech of Spanish speakers between 15 and 34 years, whose mother tongue is Spanish. However, for the Spanish dominant speakers, no similar trend has been identified.

The results, albeit non-significant, do not seem to fit with the hypothesis that no differences would be find to occur across all three age groups of the overall Catalan bilingual speakers. A clear trend has been developed for the group of Catalan speakers, whose parents are both Catalans, according to which, their acoustic distance for both /e/-/ɛ/ and /o/-/ɔ/ grows progressively larger across age groups. As regards the Catalan-dominant group, such a progressive increase across age groups is exclusively related to the acoustic distance between the vowels of the mid-back vowel pair. However, across all Catalan bilinguals, the older age group (55-75 years) was found to exhibit the highest mean score difference for both /e/-/ɛ/ and /o/-/ɔ.

While the following trend (Spanish males > Spanish females) can cast doubt on the hypothesis that females perform better than males, the prediction that **Catalan females exhibit a better mid-vowel distinction than Spanish females fully confirms this hypothesis.** The interactions processing gender and language dominance as well as gender and mother tongue factors, appear to be somewhat relevant to the validation of this hypothesis. It is primarily supported by a statistically significant difference for /o/-/ɔ/, found between the mean scores of Catalan females and males as well as between the mean scores of Catalan females and Spanish females. Thus, what can be suggested for the Catalan bilingual group, is that the mid-back vowel contrast is by far better attained by Catalan-dominant and Catalan-speaking females than males, and better preserved by Catalan females than Spanish females.

4.2.2 Outcomes beyond the scope of hypotheses

Gender and age. Females do not perform that differently from males, has been the first finding I came up with, which determines quite accurately in both experiments the strength of the variable of gender. To further discuss gender in correlation with age, the behaviour of older females and males in the speech community under study is complementary to the extent that the older the males are, the better they preserve the mid-front vowel contrast, while, the older the females are, the better they retain the mid-back vowel contrast. No satisfactory explanation can be provided, from the current data, for the occurrence of this non-significant trend followed by language dominant and mother tongue speakers, according to which bilinguals' mid-vowel differentiation becomes more robust with age under the circumstances described above. The same trend entails a better mid-front vowel differentiation achieved by younger bilingual females across both experiments as well as a more robust mid-back vowel distinction made by middle-aged males, which is mostly highlighted in the mother tongue experiment. Further research is needed to account for the reasons behind this trend.

Gender and language dominance / mother tongue. Throughout both language dominance and mother tongue experiments Catalan females achieved significance for /o/-/ɔ/ (Catalan females > Catalan males, Spanish females). Although it is non-significant, there is compelling evidence to diversity, so within the Spanish-dominant group as within the Spanish-speaking group, to the

extent that the mid-vowel contrast is better preserved by males than females. Thus, language dominance and mother tongue differentiation seems to be prior to gender-based differences across both experiments and subsequently opposed to the devised hypothesis presented above, that females perform better than males. It should be recalled that this hypothesis is bolstered exclusively by evidence provided for the Catalan bilingual group, where differences in the vowels of /e/-/ɛ/ and /o/-/ɔ/ are both gender-and language dominance-marked as well as both gender-and mother tongue-marked. It can be also argued, that significance for the Catalan-dominant and the Catalan-speaking females was achieved not only due to the effect of gender, but also due to the strength that lies in their language dominance and L1 to produce mid-vowel pairs more accurately than the Spanish-dominant and Spanish-speaking females.

The generalisation that can be made from the fact that Catalan females perform better than Catalan males is resonant with prior conclusions reached by scholars, and mentioned in section 1.4, such as 'Females show a greater sensibility to socially evaluative linguistic forms than do males' (Wolfram 1969: 78).

Age and language dominance / mother tongue. A trend towards a better mid-vowel differentiation was supported by Spanish speakers of 15-34 years, while the same trend was supported by Catalan speakers of 55-75 years. What best accounts for the fact that young Spanish speakers have come up with a robust mid-vowel production in Catalan, is that youngsters as well as young subjects of the Spanish bilingual group, who, in present time, are in their early thirties, have been educated through their L2 (Catalan), since they attended school a few years after the Language Normalisation Act in 1983 (see footnote 2 in Introduction for a discussion of this). As a result, Spanish speakers of 15-34 years, successfully command Catalan mid-vowels particularly because school instruction in early stages of their education was given exclusively in Catalan. It should be noted that the fact that Spanish speakers are educated through their L2, becomes evident only in the mother tongue experiment results, as according to the language dominance experiment results, there were no clear trends observed regarding the impact of school instruction delivered in Catalan.

A possible explanation for the opposite trend found in the speech of youngsters and young Catalan speakers, would be that the effect of speech accommodation in the social setting is quite strong for them. Catalan speakers often find themselves in a situation that requires accommodation to Spanish, as Spanish-speaking immigrants from Latin American and other regions of Spain, who represent the hispanophone monoligual group, reside in Barcelona. It can be deduced that the accommodation impact of Spanish is mostly reflected in the speech of younger Catalan speakers than older ones.

To sum up, the relative mid-vowel differentiation associated with the younger the Spanish speakers are, the better they perform, has been found as occurring exclusively in the mother tongue experiment, along a dataset of 58 bilinguals split into Catalan/Spanish speakers, markedly narrower than the one of 72 bilinguals employed in the language dominance experiment. What can be inferred is that a different pattern could have arisen if more subjects had got involved in the mother tongue experiment.

Beyond the former outstanding exception identified between the statistical test results, I shall now shed light on a great deal of similarities provided by both statistical tests this study includes. A plausible explanation I can offer for why both language dominance and mother tongue experiments provided so similar results, is that the dataset employed in both experiments is the same; 72 bilingual subjects classified by language dominance (Catalan/Spanish) were further narrowed down to 58 bilingual subjects, according to a division made upon mother tongue (Catalan parents/ Spanish parents). Bilinguals whose parents were not both of the same language group had been excluded for the reasons I stated earlier in section 2.2.3. To further specify what lies behind such a broad similarity between experiments, I should recall that modules 1 and 2 of the BLP profile test administered to participants for assessing language dominance (see section 2.1.4), had already evaluated to a certain extent bilinguals' mother tongue. A set of questions pertaining to language history and language use, such as years spent in a family where each language is spoken and percentage of use of each language in an average week with family, helped to delineate among speakers, whose mother tongue is Catalan and whose Spanish. Besides this first sort of classification of speakers by mother tongue, as resulted from the BLP, it should be reminded that I additionally proceeded with the mother tongue grouping based on speakers' answers to FAQs

questionnaire (e.g. where your parents are from? What language(s) do they use?), following the questions that are listed from Q9 to Q12 in section 2.1.2.

Overall, the number of speakers whose mother tongue is Spanish (24) completely coincides with the number of speakers whose language dominance is Spanish (24). The number of speakers whose mother tongue is Catalan (34) is very close to the number of speakers whose language dominance is Catalan (30), with only 4 Catalan-dominant speakers who have Spanish as mother tongue. Both these 24 Spanish bilinguals and these 30 Catalan bilinguals have been checked through the language dominance and mother tongue datasets and identified as being the same individuals. As for the remaining 14 language-dominant speakers, no satisfactory explanation is required to be provided, since they are not involved in both experiments.

It is not therefore odd for an almost perfect match to arise between speakers whose L1 is Catalan and speakers whose language dominance is Catalan as well as between speakers whose L1 is Spanish and speakers whose language dominance is Spanish. This, consequently, has leaded the language dominance statistical results to bear a striking resemblance to the mother tongue statistical results.

4.3 Implications and contribution to knowledge

This thesis has offered an insight into in the study of language variation found in the Catalan, Spanish speech community of Barcelona. It has also offered an assessment of the effects of every single factor, gender, age, language dominance and mother tongue, as well as of the interaction influence found in the mid-vowel production in Catalan.

In addition, it has offered the possibility of understanding that the language dominance and mother tongue effects, when taken as single effects, impact equally the identification of mid-vowel differences by the fact that Catalan bilinguals outperform Spanish bilinguals. The same conclusion can be drawn from the analysis of language dominance/mother tongue when each of these variables got involved in any of the interactional contexts this study investigates, with the exception of the age and mother tongue interaction. Greater importance was conferred on age when the mother tongue factor was considered.

A common ground between the present thesis and all of the papers that have focused, entirely or not, on the production of mid-vowels in Catalan (Lleó et al. 2008; Amengual 2011; Simonet 2011) is that all these studies point to the need to account for variation in the production of Catalan vowels as well as to determine the influence of Spanish, which is embedded in society.

The paper offered by Simonet (2011) has considerably contributed to our understanding of production of the mid-back vowel phonemes in Catalan and Spanish by both dominant (Catalan, Spanish) groups. The author has approached effectively the issue of variation by running a two-fold comparison; first between Catalan-dominant bilinguals producing the /o/-/ɔ/ Catalan vowels with Spanish-dominant bilinguals producing the /o/-/ɔ/ Catalan vowels, and second between Spanish-dominant bilinguals producing the /o/ Spanish vowel with Catalan-dominant bilinguals producing the /o/ Spanish vowel. Although these comparisons cover a wide range of aspects of acoustic distribution for the Catalan mid-vowel phonemes, they are strongly related to the mid-back vowel contrast and not to the mid-front one.

The basic components found in the design of the study conducted by Amengual (2011), such as division of participants into two dominant groups (Catalan, Spanish) upon their responses to a questionnaire, proved essential for assessing a keynote social factor that my study also investigates, that of language dominance. In resonance with language dominance, this thesis project has also been concerned with mother tongue, as my research orientation has been to interpret gender, age, language dominance and mother tongue along the axis of two experiments (language dominance and mother tongue).

The study of Lleó et al. (2008) has efficiently investigated the role of age generation effects in the production of the mid-front and mid-back Catalan vowels and schwa, as produced by Catalan/Spanish bilinguals. Their research conducted in Barcelona, gave rise to a contradictory finding to what my experimental work has come up with. The authors found that the social setting effect of a Spanish-speaking district of Barcelona (*Nou Barris*) has the most important impact on the production of Catalan vowels, as the linguistic performance of younger generation groups who live in this district was poor in comparison to older generation groups.

The current research does not discount the effect of social setting but simply builds on the results of this study to depict that the effect of school outperforms the effect of social setting; younger Spanish bilingual speakers educated through their L2 (Catalan) exhibit a better mid-front and mid-back vowel differentiation than older Spanish bilingual speakers. The thesis findings can be viewed as a reliable representation of language variation triggered by social factors as a relatively large-scale survey of 72 participants for the language dominance experiment and of 58 participants for the mother tongue experiment, has been used in the present study. The conclusion that language dominance and mother tongue gain ground in the speech production of each bilingual group, relies on the fact that when each of the language dominance and the mother tongue factors was patterned with gender, it steered gender towards significance and when each of these factors was patterned with age, it gave rise to a set of appealing trends.

Nevertheless, the issue of language change appears not to be involved in the present study presumably because the current data is examined from the perspective of an apparent-time approach. A future study from a real-time perspective is therefore suggested as it would allow conclusions to be drawn regarding the role of language dominance, gender, age and mother tongue in phonological change providing insight into the non-linear nature of change in Central Catalan. Resampling the same range of data at a different point in time, leaves room for a number of quite different correlations between the use of mid-vowels in Catalan and bilinguals' age to emerge over time.

Alternatively, it propels us to suggest that further research is required to shed light on the same range of vowel changes, involving more bilingual subjects and probably more social factors to be patterned with language dominance and mother tongue, such as social class and education level. By doing so, an intriguing language development issue could be tackled, as a change in Central Catalan may result from the influence of Spanish or follow an internal evolution process of its own.

APPENDIX A

The FAQs questionnaire in Catalan

A. Demografia i llengües parlades amb la família i els amics

Q1: Com es diu? / Com et dius?

Q2: Vostè d'on és? / D'on ets?

Q3: On viu? / On vius?

Q4: Quant temps porta vivint a Barcelona? / Quant temps portes vivint a Barcelona?

Q5: Vostè de què fa? / De què fas?

Q6: Quantes llengües parla? / Quantes llengües parles?

Q7: Ja que té més d'una llengua, en quina llengua es comunica normalment amb la seva família? / Ja que tens més d'una llengua, en quina llengua et comuniques normalment amb la teva família?

Q8: En quina llengua es comunica amb els seus amics? / En quina llengua et comuniques amb els teus amics?

Q9: D'on són els seus pares? / D'on són els teus pares?

Q10: Quina llengua fan servir?

Q11: D'on són els seus avis? / D'on són els teus avis?

Q12: Quina llengua fan servir?

B. Educació

Q13: A quina escola primària va assistir? / A quina escola primària vas assistir?

Q14: A quina escola secundària va assistir? / A quina escola secundària vas assistir?

Q15: A l'escola primària i secundària i a la universitat, en quina llengua s'imparteixen les classes?

Q16: Quantes hores es donen en català i quantes en espanyol?

C. Aficions i família

Q17: Passes molt de temps amb la família?

Q18: Es considera proper/-a a la seva família? / Et consideres proper/-a a la teva familia?

Q19: Què li agrada fer en el temps lliure? / Què t'agrada fer en el temps lliure?

Q20: On passa principalment el temps lliure? / On passes principalment el temps lliure?

Q21: Podria anomenar una afició que no li costa res? / Podries anomenar una afició que no et costa res?

D. Bilingüisme

Q22: S'ha calculat que més de la meitat de la població mundial és bilingüe, és a dir, viu amb dos o més idiomes. Què opineu del bilingüisme?

APPENDIX B

The English version of the Catalan text

The cup of coffee has been left intact. Esteve was rather not fond of tasting it as he had quitted smoking and drinking coffee during the last months. A few minutes were missing for quarter to seven to reach, but he was behaving as if he should wait an eternity for her. He had an appointment with Ester quarter to seven in the evening. He was thinking of visiting Miquel in his flat at nine as he was not living far away from the coffee shop. Miquel was working at the restaurant "Seven Doors", one of the most emblematic in the city with more than two hundred years of history. He arrived early to the meeting because, in general, he used to be punctual every time he had an appointment. On the contrary, she used to arrive late every time she had one. The small coffee shop where he was waiting for her was located on number 2, "Progress Street", a few meters down the street from the "Reform Square". While he was thinking of ordering a drink that he could try, for instance, a cup of chocolate or a milkshake, his eyes caught the headlines of the newspaper on the top of the pile of newspapers under the table. He shut his eyes to the headline: "Nowadays, in Spain, more bicycles than cars are being sold". Recently, he has been thinking of buying one and, although he was tempted to pedal, he should have a place to store it. His flat was so small that he could barely store his clothes. Apart from his talent for cycling, Esteve had a great talent for music. Talent is a beloved skill. Instead, his father would rather he completed his studies to get a university degree as physiotherapist than he devoted his life to music. In fact, he had already received the fundamentals of music playing the organ in a church. In his youth, he wanted to become a priest. After completing his studies at the Institute of the city, he abandoned though the idea of becoming a priest. His wife had a great ability to draw. He thought that it would be better if she was gifted with sensitivity, than bringing with her just material wealth as a dowry.

APPENDIX C

The Bilingual Language Profile (BLP) in Catalan/Spanish

Catalan Version

Bilingual Language Profile: Català- Espanyol

Ens agradaría demanar la seva ajuda per contestar a les següents preguntes sobre el seu historial lingüístic, ús, actituds i competencia. Aquesta enquesta conté 19 preguntes i li durà menys de 10 minuts per completar. Això no és una prova, per tant no hi ha resposes correctes ni incorrectes. Per favor contesti cada pregunta i respongui amb sinceritat, ja que només així es podrá garantir l´èxit d´aquesta investigació. Moltes gràcies per la seva ajuda.

I. Informació biogràfica

Nom _____	Data d´avui ____/____/____
Edat	☐ Home / ☐ Dona
Lloc de residencia actual: ciutat/estat	País

Nivell més alt de formació acadèmica:	☐ Menys de l´escola secundària	☐ Escola secundària
	☐ Un poc d´universitat	☐ Universitat (diplomatura, llicenciatura.)
	☐ Un poc d´escola graduada	☐ Máster
	☐ Doctorat	☐ Altre: _____

Please cite as :
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1

II. Historial lingüístic

En aquesta secció, ens agradaría que contestés algunes preguntes sobre el seu historial lingüístic marcant la casella apropiada.

1. ¿A quina edat **va començar a aprendre** les següents llengües?

Català

☐ Desde el Naixement ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Espanyol

☐ Desde el Naixement ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

2. A quina edat **va començar a sentir-se còmode** usant les següents llengües?

Català

☐ Tan prest com record ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ encara no

Espanyol

☐ Tan prest com record ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ encara no

3. Quants **anys de clases (gramática, historia, matemàtiques, etc..)** ha tingut en les següents llengües (des de l'escola primària a la universitat)?

Català

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Espanyol

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

4. Quants anys **ha passat en un país/regió** on es parlen les següents llengües?

Català

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Espanyol

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

5. Quants anys ha passat en **família** parlant les següents llengües?

Català

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Espanyol

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

6. Quants anys ha passat en un **ambient de treball** on es parlen les següents llengües?

Català

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Espanyol

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

III. Ús de llengües

En aquesta secció, ens agradaria que contestés algunes preguntes sobre el seu ús de llengües marcant la casella apropiada. L´ús total de totes les llengües en cada pregunta ha d´arribar al 100%.

7. En una setmana normal, quin percentatge del temps usa les següents llengües amb els **seus amics**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Català	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Espanyol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Altres llengües	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. En una semana normal, quin percentatge del temps usa les següents llengües amb la **seva família**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Català	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Espanyol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Altres llengües	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. En una semana normal, quin percentatge del temps usa les següents llengües a **l'escola/la feina**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Català	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Espanyol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Altres llengües	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Quan es parla a vostè mateix, amb quina freqüència **es parla a si mateix** en les següents llengües?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Català	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Espanyol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Altres llengües	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. Quan fa càlculs contant, amb quina freqüència conta en les següents llengües?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Català	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Espanyol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Altres llengües	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

IV. Competència

En aquesta secció, ens agradaria que considerés la seva competencia de llengua marcant la casella de 0 a 6.

	0=no massa bé						*6=molt bé*
12. a. Com parla en **Català**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. Com parla en **Espanyol**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
13. a. Com entén en **Català**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. Com entén en **Espanyol**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
14. a. Com llegeix en **Català**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. Com llegeix en **Espanyol**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
15. a. Com escriu en **Català**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. Com escriu en **Espanyol**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6

V. Actituds

En aquesta secció, ens agradaría que contestés a les següents afirmacions sobre actituds lingüístiques marcant les caselles de 0 a 6.

0=no estic d'acord *6=estic d'acord*

16. a. Em sento "jo mateix" quan parlo en **Català**. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

    b. Em sento "jo mateix" quan parlo en **Espanyol**. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

17. a. M'identifico amb una cultura **Catalanoparlant**. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

    b. M'identifico amb una cultura **Castellanoparlant**. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

18. a. És important per a mi usar/arribar a usar **Català** com un parlant nadiu. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

    b. És important per a mi usar/arribar a usar **Espanyol** com un parlant nadiu. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

19. a. Vull que els altres pensin que sóc un parlant nadiu de **Català**. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

    b. Vull que els altres pensin que sóc un parlant nadiu **d'Espanyol**. ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

Spanish Version

Bilingual Language Profile: Español- Catalán

Nos gustaría pedir su ayuda para contestar a las siguientes preguntas sobre su historial lingüístico, uso, actitudes y competencia. La encuesta contiene 19 preguntas y le llevará menos de 10 minutos para completar. Esto no es una prueba, por tanto no hay respuestas correctas ni incorrectas. Por favor conteste cada pregunta y responda con sinceridad, ya que solamente así se podrá garantizar el éxito de esta investigación. Muchas gracias por su ayuda.

I. Información biográfica

Nombre	Fecha de hoy / /
Edad ____ ☐ Hombre / ☐ Mujer	Lugar de residencia actual: ciudad/estado _____ País _____

Nivel más alto de formación académica: ☐ Menos de la escuela secundaria ☐ Escuela Secundaria
☐ Un poco de universidad ☐ Universidad (diplomatura, licenciatura.)
☐ Un poco de escuela graduada ☐ Máster
☐ Doctorado ☐ Otra: _____

Please cite as :
Birdsong, D., Gertken, L.M., & Amengual, M. *Bilingual Language Profile: An Easy-to-Use Instrument to Assess Bilingualism*. COERLL, University of Texas at Austin. Web. 20 Jan. 2012. <https://sites.la.utexas.edu/bilingual/>.

II. Historial lingüístico

En esta sección, nos gustaría que contestara algunas preguntas sobre su historial lingüístico marcando la casilla apropiada.

1. ¿A qué edad **empezó a aprender** las siguientes lenguas?

Español

☐ Desde el Nacimiento ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Catalán

☐ Desde el Nacimiento ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

2. ¿A qué edad **empezó a sentirse cómodo** usando las siguientes lenguas?

Español

☐ Tan pronto como recuerdo ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ aún no

Catalán

☐ Tan pronto como recuerdo ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ aún no

3. ¿Cuántos años de **clases (gramática, historia, matemáticas, etc..)** ha tenido en las siguientes lenguas (desde la escuela primaria a la universidad)?

Español

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Catalán

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

4. ¿Cuántos años ha pasado en un **país/región** donde se hablan las siguientes lenguas?

Español

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Catalán

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

5. ¿Cuántos años ha pasado en **familia** hablando las siguientes lenguas?

Español

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Catalán

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

6. ¿Cuántos años ha pasado en **un ambiente de trabajo** donde se hablan las siguientes lenguas?

Español

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Catalán

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

III. Uso de lenguas

En esta sección, nos gustaría que contestara algunas preguntas sobre su uso de lenguas marcando la casilla apropiada. El uso total de todas las lenguas en cada pregunta debe llegar al 100%.

7. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas con **sus amigos**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Catalán	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas con **su familia**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Catalán	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas en **la escuela/el trabajo**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Catalán	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Cuando se habla a usted mismo, ¿con qué frecuencia **se habla a sí mismo** en las siguientes lenguas?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Catalán	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. Cuando hace cálculos contando, ¿con qué frecuencia **cuenta** en las siguientes lenguas?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Catalán	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

IV. Competencia

En esta sección, nos gustaría que considerara su competencia de lengua marcando la casilla de 0 a 6.

	0=no muy bien						*6=muy bien*
12. a. ¿Cómo habla en **Español**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. ¿Cómo habla en **Catalán**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
13. a. ¿Cómo entiende en **Español**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. ¿Cómo entiende en **Catalán**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
14. a. ¿Cómo lee en **Español**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. ¿Cómo lee en **Catalán**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
15. a. ¿Cómo escribe en **Español**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. ¿Cómo escribe en **Catalán**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6

V. Actitudes

En esta sección, nos gustaría que contestara a las siguientes afirmaciones sobre actitudes lingüísticas marcando las casillas de 0 a 6.

0=no estoy de acuerdo *6=estoy de acuerdo*

16. a. Me siento "yo mismo" cuando hablo en **Español**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Me siento "yo mismo" cuando hablo en **Catalán**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

17. a. Me identifico con una cultura **Hispanohablante**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Me identifico con una cultura **Catalanohablante**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

18. a. Es importante para mi usar/llegar a usar **Español** como un hablante nativo. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Es importante para mi usar/llegar a usar **Catalán** como un hablante nativo. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

19. a. Quiero que los demás piensen que soy un hablante nativo de **Español**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Quiero que los demás piensen que soy un hablante nativo de **Catalán**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

APPENDIX D

List of unnormalised and normalised F1 and F2 values and social factor classification per speaker

Num	Speaker	Vowels	F1 unnorm	F2 unnorm	F1 norm	F2 norm	Age	Gender	L1	Lang dom
1	NP	i	409	2158	-1,0	1,2	15-34	F	Cat	Cat
		e	490	1957,3	-0,2	0,8				
		ɛ	593,2	1778,5	0,9	0,5				
		a	641,8	1700	1,4	0,3				
		ɔ	561,2	1344,8	0,6	-0,4				
		o	460,5	965,2	-0,5	-1,1				
		u	382	783,8	-1,3	-1,4				
2	CL	i	359	2358,6	-1,2	1,4	15-34	F	Cat	Cat
		e	438,3	1996,5	-0,7	0,8				
		ɛ	658,3	1857,7	0,6	0,5				
		a	780,2	1544,2	1,4	0,0				
		ɔ	704,8	1285,2	0,9	-0,5				
		o	529	1040,8	-0,1	-0,9				
		u	393	783	-1,0	-1,4				
3	GA	i	318,2	2093,4	-1,4	1,6	15-34	F	Cat	Cat
		e	438,3	1857,7	-0,6	0,9				
		ɛ	575,3	1672,8	0,3	0,4				
		a	709,3	1385,5	1,2	-0,4				
		ɔ	627,2	1272,2	0,7	-0,7				
		o	630	1270,8	0,7	-0,7				
		u	370,3	1133,2	-1,0	-1,1				
4	SE	i	257	2322,3	-1,3	1,4	15-34	F	Cat ♂ Sp ♀	Cat
		e	434,3	1965,3	-0,4	0,7				
		ɛ	647	1818,3	0,6	0,4				

		a	811,3	1634,8	1,3	0,1				
		ɔ	729,2	1343	0,9	-0,5				
		o	523,3	1275	0,0	-0,6				
		u	302,3	797,2	-1,1	-1,6				
5	IA	i	277,4	2511,7	-1,4	1,3	15-	F	Cat	Cat
		e	478	2328	-0,4	1,0	34			
		ɛ	735,4	2118,3	0,9	0,6				
		a	794,3	1561,2	1,2	-0,3				
		ɔ	706,5	1440,8	0,8	-0,5				
		o	548,5	1294,8	0,0	-0,7				
		u	364,7	859,3	-1,0	-1,4				
6	EM	i	318,2	2124	- 1,4	1,4	15-	F	Sp ♂	Cat
		e	435,5	1857,7	- 0,7	0,7	34		Cat♀	
		ɛ	630	1768	0,5	0,5				
		a	746,2	1569,7	1,2	0,0				
		ɔ	669,7	1377	0,8	-0,5				
		o	638,7	1360	0,6	-0,5				
		u	393	936	-0,9	-1,6				
7	JP	i	299,5	2179,3	-1,5	1,3	15-	F	Cat	Cat
		e	572,6	1977,8	0,1	0,9	34			
		ɛ	652,7	1838,6	0,6	0,6				
		a	745,6	1538,5	1,1	-0,1				
		ɔ	664	1453,3	0,6	-0,3				
		o	624,3	1230	0,4	-0,7				
		u	336,3	805,7	-1,3	-1,6				
8	HP	i	463,2	2016	-1,0	1,5	15-	M	Cat	Cat
		e	502,8	1685,3	-0,5	0,6	34			
		ɛ	590,5	1710	0,7	0,7				
		a	651,7	1433	1,6	-0,1				
		ɔ	551,3	1217,3	0,2	-0,7				
		o	553,7	1197,8	0,2	-0,7				

		u	443,3	997	-1,3	-1,3				
9	AV	i	373,2	2036,2	-1,4	1,4	15-	M	Cat	Cat
		e	517,5	1711,3	-0,2	0,7	34			
		ɛ	517,5	1705,7	-0,2	0,6				
		a	720,7	1490,3	1,4	0,1				
		ɔ	635,7	1148,2	0,7	-0,7				
		o	632,8	1137	0,7	-0,7				
		u	427	817	-1,0	-1,5				
10	DR	i	390,2	2036,2	-1,2	1,4	15-	M	Cat	Cat
		e	480,8	1845,2	-0,6	0,9	34			
		ɛ	675,3	1756,7	0,7	0,7				
		a	774,5	1436,5	1,3	-0,1				
		ɔ	723,5	1232,5	1,0	-0,6				
		o	522,2	1078,8	-0,3	-1,0				
		u	435,5	1004	-0,9	-1,2				
11	JVA	i	376	2163,7	-1,6	1,5	15-	M	Cat	Cat
		e	596	1717	0,0	0,5	34			
		ɛ	635,7	1677,3	0,3	0,4				
		a	771,7	1501,7	1,3	0,1				
		ɔ	675,3	1269,3	0,6	-0,5				
		o	675,3	1263,7	0,6	-0,5				
		u	452,5	743,3	-1,1	-1,6				
12	ACC	i	330,7	2010,7	-1,7	1,8	15-	M	Cat ♂	Cat
		e	602	1598	0,2	0,5	34		Sp	
		ɛ	613	1589,5	0,3	0,5			♀	
		a	709,3	1399,7	1,0	-0,1				
		ɔ	658,3	1224	0,6	-0,7				
		o	664	1218,3	0,7	-0,7				
		u	415,7	1032,3	-1,1	-1,2				
13	PC	i	446,8	2084,5	-1,7	1,3	35-	F	Cat	Cat
		e	614,8	1893,3	0,1	0,8	54			

		ɛ	675,8	1779,7	0,7	0,6				
		a	745,2	1640	1,4	0,2				
		ɔ	631	1210,3	0,2	-0,8				
		o	608,5	1280,7	0,0	-0,6				
		u	535	910,8	-0,8	-1,5				
14	S	i	364,7	2457,3	-1,4	1,4	35-	F	Cat	Cat
		e	512	2104,2	-0,4	0,8	54			
		ɛ	655,5	1979,5	0,5	0,6				
		a	794,3	1569,7	1,5	-0,1				
		ɔ	692,3	1260,8	0,8	-0,6				
		o	579,5	1029,3	0,0	-1,0				
		u	446,8	848,2	-0,9	-1,3				
15	CE	i	299,5	2404	-1,6	1,3	35-	F	Cat	Cat
		e	604,5	2217,5	0,2	1,0	54			
		ɛ	647	1999,3	0,5	0,7				
		a	794,3	1484,7	1,3	-0,2				
		ɔ	689,5	1140	0,7	-0,7				
		o	551,7	1046,5	-0,1	-0,9				
		u	387,3	868	-1,0	-1,2				
16	RM	i	387,3	2485,7	-1,6	1,4	35-	F	Cat	Cat
		e	588	2370,5	-0,2	1,2	54			
		ɛ	675,3	1857,7	0,3	0,3				
		a	839,7	1479	1,4	-0,3				
		ɔ	749	1269,3	0,8	-0,6				
		o	630	1190	0,0	-0,7				
		u	506,3	851	-0,8	-1,3				
17	AT	i	361,8	2305,3	-1,4	1,4	35-	F	Sp ♂	Cat
		e	503,5	2183,5	-0,5	1,1	54		Cat♀	
		ɛ	669,7	1846,3	0,6	0,4				
		a	777,3	1549,8	1,4	-0,2				
		ɔ	698	1292	0,8	-0,7				

		o	565,3	1167,8	0,0	-0,9				
		u	427	1040,8	-1,0	-1,2				
18	GCM	i	462,4	2079,5	-0,8	1,6	35-	M	Cat	Cat
		e	487,7	1849,5	-0,5	1,0	54			
		ɛ	588	1700	0,5	0,6				
		a	732,3	1420,8	1,9	-0,1				
		ɔ	583,2	1148,8	0,4	-0,8				
		o	495	1087,7	-0,4	-1,0				
		u	431,5	957,8	-1,1	-1,3				
19	AA	i	333,5	2005	-1,3	1,5	35-	M	Cat	Cat
		e	444	1748,2	-0,5	0,8	54			
		ɛ	623,2	1706,8	0,8	0,7				
		a	703,7	1396,8	1,3	-0,2				
		ɔ	647	1167,7	0,9	-0,8				
		o	477,8	1139,8	-0,3	-0,8				
		u	384,5	1018,2	-0,9	-1,2				
20	JS	i	231,5	2268,5	-1,5	1,5	35-	M	Cat ♂	Cat
		e	478	1829,7	0,0	0,7	54		Sp	
		ɛ	586,2	1683	0,7	0,5			♀	
		a	732	1506,2	1,5	0,2				
		ɔ	486,5	929,2	0,1	-0,8				
		o	509,2	904,8	0,2	-0,9				
		u	318,2	711,6	-1,0	-1,2				
21	JV	i	347,7	2178,4	-1,3	1,4	35-	M	Cat	Cat
		e	458,2	1957,4	-0,7	0,9	54			
		ɛ	644,2	1731	0,4	0,5				
		a	783	1496	1,3	0,0				
		ɔ	715	1241	0,9	-0,5				
		o	654,2	1122,5	0,5	-0,8				
		u	396,4	791,5	-1,0	-1,5				

22	A	i	325	2178,4	-1,4	1,4	35-	M	Cat	Cat
		e	554	1916,6	0,1	0,9	54			
		ɛ	664	1806,7	0,8	0,6				
		a	769,4	1470,5	1,5	-0,1				
		ɔ	596,3	1072	0,4	-0,9				
		o	486,5	1106	-0,4	-0,8				
		u	390,2	961,5	-1,0	-1,1				
23	AC	i	344,8	2123,8	-1,6	1,4	35-	M	Cat	Cat
		e	505,2	1821	-0,3	0,6	54			
		ɛ	623,2	1773,3	0,7	0,5				
		a	687,8	1560,6	1,2	0,0				
		ɔ	609,8	1397,4	0,6	-0,5				
		o	585	1404,2	0,4	-0,4				
		u	429,8	933,2	-0,9	-1,7				
24	MO	i	330,7	2132,5	-1,4	1,4	35-	M	Cat	Cat
		e	483,7	1854,8	-0,4	0,8	54			
		ɛ	579,2	1753,8	0,3	0,6				
		a	757,5	1476,6	1,6	0,1				
		ɔ	635,7	1120	0,7	-0,7				
		o	523,3	983,6	-0,1	-1,0				
		u	424,2	839,7	-0,8	-1,3				
25	YS	i	427	2277	-1,0	1,3	55-	F	Cat	Cat
		e	529	2132,5	-0,4	1,0	75			
		ɛ	576,7	1874,7	-0,1	0,4				
		a	945,2	1714,2	2,0	0,0				
		ɔ	708,2	1479	0,6	-0,5				
		o	546	1428	-0,3	-0,7				
		u	480,8	1066	-0,7	-1,5				
26	MT	i	330,7	2328	-1,4	1,3	55-	F	Cat	Cat
		e	495	2155,2	-0,3	1,0	75			
		ɛ	590,7	1981,2	0,4	0,7				

		a	743,3	1513	1,4	-0,2				
		ɔ	664,2	1258	0,9	-0,7				
		o	543,2	1209,8	0,0	-0,7				
		u	393	868	-1,0	-1,4				
27	RB	i	381,7	2090	-1,4	1,4	55-	F	Cat	Cat
		e	520,5	1894,5	-0,4	0,9	75			
		ɛ	652,7	1776,3	0,6	0,6				
		a	783	1504,5	1,5	-0,1				
		ɔ	686,7	1286,3	0,8	-0,6				
		o	551,7	1094,7	-0,2	-1,1				
		u	452,5	1046,5	-0,9	-1,2				
28	CCB	i	321,6	2056	-1,3	1,2	55-	F	Cat	Cat
		e	464,4	1926,8	-0,5	0,9	75			
		ɛ	649,8	1809,7	0,7	0,7				
		a	751,8	1595,2	1,3	0,2				
		ɔ	706,5	1190	1,0	-0,8				
		o	515,4	1136,6	-0,2	-0,9				
		u	381,7	975,7	-1,0	-1,3				
29	MF	i	319,3	2322,3	-1,4	1,5	55-	F	Cat	Cat
		e	483,7	2124	-0,5	1,1	75			
		ɛ	664	1818,3	0,5	0,4				
		a	834	1439,3	1,4	-0,4				
		ɔ	732	1360	0,8	-0,5				
		o	613	1179	0,2	-0,9				
		u	410	1043,7	-0,9	-1,2				
30	PM	i	353,3	2502,7	-1,3	1,6	55-	F	Cat	Cat
		e	495	1908,7	-0,4	0,6	75			
		ɛ	664	1863,3	0,6	0,5				
		a	777,3	1547	1,3	0,0				
		ɔ	715	1224	1,0	-0,6				
		o	529	1140	-0,2	-0,8				

		u	421,3	839,7	-0,9	-1,3				
31	MP	i	376	2393,2	-1,4	1,6	55-	F	Sp ♂	Cat
		e	559,8	1931,3	-0,3	0,7	75		Cat♀	
		ɛ	677,6	1776,3	0,4	0,4				
		a	851	1513	1,4	-0,1				
		ɔ	743,3	1207	0,8	-0,7				
		o	638,5	1148,5	0,2	-0,8				
		u	421,3	919	-1,1	-1,2				
32	RMC	i	322,2	2277	-1,4	1,6	55-	F	Cat	Cat
		e	506,3	1982,3	-0,3	0,7	75			
		ɛ	661,2	1778,8	0,4	0,4				
		a	856,7	1374,2	1,4	-0,1				
		ɔ	749	1275	0,8	-0,7				
		o	546	1190	0,2	-0,8				
		u	444	1021	-1,1	-1,2				
33	FM	i	362,4	1979,5	-1,3	1,3	55-	M	Cat	Cat
		e	467,8	1858,8	-0,4	1,0	75			
		ɛ	539,2	1723,8	0,2	0,6				
		a	708,2	1519,8	1,5	0,0				
		ɔ	644,3	1314,7	1,0	-0,5				
		o	492,2	1153,8	-0,2	-1,0				
		u	415,7	1023,8	-0,8	-1,3				
34	JN	i	339,2	2325,2	-1,3	1,6	55-	M	Cat	Cat
		e	452,5	1877,5	-0,6	0,7	75			
		ɛ	636,8	1734	0,6	0,4				
		a	770,3	1540,2	1,4	0,1				
		ɔ	675,3	1156,6	0,8	-0,6				
		o	523,3	1035,2	-0,1	-0,9				
		u	398,7	825,5	-0,9	-1,3				
35	JPC	i	359	2180,7	-1,3	1,5	55-	M	Cat	Cat
		e	478	1886	-0,4	0,8	75			

		ɛ	624,3	1756,7	0,8	0,5				
		a	743,3	1541,3	1,7	0,0				
		ɔ	534,7	1151,3	0,1	-0,8				
		o	523,3	1162,3	0,0	-0,8				
		u	435,5	975,7	-0,7	-1,2				
36	JF	i	342	2192	-1,1	1,5	55-	M	Cat	Cat
		e	449,7	1880,3	-0,5	0,8	75			
		ɛ	766	1768	1,1	0,6				
		a	856,7	1484,7	1,6	-0,1				
		ɔ	517,7	1162,3	-0,2	-0,8				
		o	517,7	1190,3	-0,2	-0,7				
		u	410	936	-0,7	-1,3				
37	AH	i	335,2	2254,3	-1,2	1,6	15-	F	Sp	Sp
		e	455,3	1835	-0,5	0,7	34			
		ɛ	601,8	1728,2	0,4	0,5				
		a	754,7	1462	1,4	-0,1				
		ɔ	695,2	1269,3	1,0	-0,5				
		o	495	1080,5	-0,2	-1,0				
		u	383,3	981,3	-0,9	-1,2				
38	ER	i	335,2	2215,8	-1,6	1,6	15-	F	Sp	Sp
		e	570,8	1722,5	0,0	0,5	34			
		ɛ	618,8	1685,8	0,3	0,5				
		a	776,2	1543,6	1,4	0,2				
		ɔ	666,8	1122,8	0,7	-0,8				
		o	638,5	1160,5	0,5	-0,7				
		u	381,7	870,3	-1,3	-1,3				
39	MC	i	312,3	2524,2	-1,3	1,4	15-	F	Sp ♂	Sp
		e	469,5	2126,8	-0,1	0,8	34		Cat♀	
		ɛ	457,6	2168,2	-0,2	0,9				
		a	726,3	1387,2	1,7	-0,2				
		ɔ	540,2	1012,5	0,4	-0,7				

		o	559,2	868	0,5	-0,9				
		u	359	689,5	-0,9	-1,2				
40	JA	i	342	2446,3	-1,5	1,5	15-	F	Sp	Sp
		e	562,2	2121,2	-0,1	0,8	34			
		ɛ	681	1993,7	0,7	0,5				
		a	774,5	1764,4	1,3	0,1				
		ɔ	644,2	1357,2	0,5	-0,8				
		o	616,4	1379,8	0,3	-0,7				
		u	406,6	1109	-1,1	-1,3				
41	BG	i	288,2	2488,5	-1,7	1,6	15-	F	Cat	Sp
		e	466,7	1962,5	-0,2	0,8	34			
		ɛ	573,8	1714,2	0,7	0,4				
		a	630	1348,7	1,2	-0,1				
		ɔ	532,4	874,8	0,4	-0,9				
		o	529	893,5	0,4	-0,8				
		u	393	752,4	-0,8	-1,0				
42	IR	i	288,2	2330,8	-1,6	1,5	15-	F	Sp ♂	Sp
		e	540,2	1931,3	-0,1	0,7	34		Cat♀	
		ɛ	534,5	1937	-0,1	0,7				
		a	825,5	1484,7	1,6	-0,1				
		ɔ	627,2	1066,3	0,4	-0,8				
		o	655,5	1023,8	0,6	-0,9				
		u	432,7	896,3	-0,7	-1,1				
43	PCR	i	308,4	2263,4	-1,5	1,4	15-	F	Cat	Sp
		e	543,2	1897,3	0,1	0,7	34			
		ɛ	542,7	1855,3	0,1	0,7				
		a	672,5	1527,6	1,1	0,1				
		ɔ	623,2	1095,8	0,7	-0,7				
		o	618,7	1103,2	0,7	-0,7				
		u	353,3	737,7	-1,2	-1,4				

44	SA	i	253,6	2480	-1,5	1,5	15-	F	Sp	Sp
		e	390,2	2005	-0,4	0,7	34			
		ɛ	478	1880,3	0,3	0,5				
		a	616,3	1538,5	1,3	-0,1				
		ɔ	523,3	1326	0,6	-0,5				
		o	523,3	1331,7	0,6	-0,5				
		u	310,8	686,7	-1,0	-1,6				
45	JB	i	392	2023,3	-1,5	1,6	15-	M	Sp	Sp
		e	524,2	1633,7	-0,2	0,5	34			
		ɛ	622,3	1626,5	0,7	0,5				
		a	708	1474,7	1,5	0,1				
		ɔ	624,7	1261,8	0,7	-0,5				
		o	521,8	1138,5	-0,3	-0,9				
		u	458,2	977,5	-0,8	-1,3				
46	JPE	i	333,5	2132,5	-1,4	1,4	15-	M	Sp	Sp
		e	520,3	1951,3	-0,3	1,0	34			
		ɛ	686,7	1688,7	0,7	0,4				
		a	783	1445	1,2	-0,1				
		ɔ	740,5	1181,5	1,0	-0,7				
		o	534,7	1083,3	-0,2	-0,9				
		u	410	963,2	-1,0	-1,2				
47	HC	i	373,2	2243	-1,5	1,4	15-	M	Cat	Sp
		e	480,8	1934,3	-0,3	0,8	34			
		ɛ	506,3	1852	0,0	0,7				
		a	627,2	1447,8	1,4	-0,1				
		ɔ	565,3	1052,2	0,7	-0,8				
		o	562,7	1055	0,6	-0,8				
		u	421,3	783	-1,0	-1,3				
48	DM	i	293,8	2240,2	-1,6	1,7	15-	M	Sp	Sp
		e	497,8	1762,2	-0,2	0,7	34			
		ɛ	606,2	1677,3	0,6	0,5				

		a	691,2	1252,3	1,2	-0,4				
		ɔ	643,6	1210,4	0,9	-0,5				
		o	535,8	1074,8	0,1	-0,8				
		u	370,3	876,5	-1,0	-1,2				
49	OT	i	384,8	1963,5	-1,4	1,4	35-	F	Sp ♂	Sp
		e	556,2	1772,8	0,3	0,8	54		Cat♀	
		ɛ	585,8	1748,7	0,7	0,8				
		a	659,7	1430,3	1,4	-0,1				
		ɔ	540,8	1145,3	0,2	-0,9				
		o	522,8	1080,7	0	-1,1				
		u	413,8	1138	-1,1	-0,9				
50	MV	i	403,2	1966,5	-1,3	1,3	35-	F	Sp	Sp
		e	514,3	1822,5	-0,3	1,0	54			
		ɛ	533,8	1746,3	-0,1	0,8				
		a	707,7	1594,7	1,4	0,5				
		ɔ	600,2	1059,5	0,5	-0,8				
		o	644,5	1085,2	0,9	-0,7				
		u	424	899	-1,1	-1,1				
51	GC	i	360,3	2104,3	-1,2	0,7	35-	F	Sp	Sp
		e	490	1834,8	-0,2	0,8	54			
		ɛ	597,8	1807,8	0,6	0,7				
		a	700,5	1452,5	1,4	0,0				
		ɔ	612,7	1168,3	0,7	-0,7				
		o	512,2	1126,7	0,0	-0,7				
		u	347,8	810,8	0,7	-0,7				
52	MA	i	257	2328	-1,6	1,5	35-	F	Sp	Sp
		e	478	1950,6	0,0	0,7	54			
		ɛ	512	1869	0,3	0,6				
		a	689,5	1479	1,5	-0,1				
		ɔ	548,5	1270,8	0,5	-0,5				
		o	503,5	1261,4	0,2	-0,6				

		u	350,5	734,8	-0,9	-1,5				
53	SR	i	257	2522,5	-1,4	1,3	35-	F	Cat ♂	Sp
		e	446,4	2180,7	-0,1	0,8	54		Sp ♀	
		ɛ	458,2	2194,8	0,0	0,8				
		a	647	1609,3	1,4	0,0				
		ɔ	542	913,3	0,6	-0,9				
		o	548,7	899,2	0,7	-0,9				
		u	296,7	693	-1,1	-1,2				
54	SL	i	308	2239,6	-1,5	1,5	35-	F	Sp	Sp
		e	559	1860,7	0,2	0,8	54			
		ɛ	613	1801,3	0,5	0,7				
		a	742,2	1260,8	1,4	-0,4				
		ɔ	602	1055	0,5	-0,8				
		o	538,8	1125,7	0,0	-0,7				
		u	372,6	889,3	-1,1	-1,1				
55	EL	i	353,3	2451,7	-1,4	1,4	35-	F	Sp	Sp
		e	472,3	2175	-0,5	1,0	54			
		ɛ	621,5	1742,5	0,7	0,4				
		a	695,2	1498,8	1,2	0,0				
		ɔ	658,3	1060,7	0,9	-0,7				
		o	534,7	987	0,0	-0,8				
		u	398,7	658,3	-1,0	-1,3				
56	SM	i	428,8	1971,8	-1,0	1,2	35-	F	Cat ♂	Sp
		e	507,2	1866,8	-0,4	0,9	54		Sp ♀	
		ɛ	646,8	1734,3	0,7	0,6				
		a	764,5	1619,3	1,5	0,3				
		ɔ	668,7	1212,5	0,8	-0,6				
		o	477,8	1036,2	-0,6	-1,1				
		u	431,3	936	-1,0	-1,3				
57	MM	i	314,8	2330,7	-1,6	1,4	35-	F	Cat	Sp
		e	534,7	2070,2	-0,2	0,9	54			

		ɛ	630	1889,4	0,4	0,5				
		a	785,8	1589,5	1,4	-0,2				
		ɔ	703,7	1363,4	0,8	-0,6				
		o	576,5	1434,8	0,0	-0,5				
		u	438,3	953	-0,8	-1,5				
58	LH	i	318,5	1998,7	-1,4	1,3	35-	M	Cat ♂	Sp
		e	507,2	1756,2	0,3	0,8	54		Sp ♀	
		ɛ	463	1626,7	-0,1	0,5				
		a	646,8	1430,5	1,5	0,1				
		ɔ	552,5	1249,3	0,7	-0,4				
		o	487,3	1124,3	0,1	-0,6				
		u	346,5	670	-1,1	-1,7				
59	JE	i	253,6	2282,7	-1,5	1,5	35-	M	Sp	Sp
		e	540	1812,7	0,1	0,7	54			
		ɛ	649,8	1751	0,7	0,6				
		a	771,7	1323,2	1,4	-0,1				
		ɔ	548,7	933,2	0,2	-0,8				
		o	528,8	845,3	0,1	-0,9				
		u	313,7	757,5	-1,1	-1,1				
60	OM	i	299,5	2291,2	-1,8	1,7	35-	M	Sp	Sp
		e	464,4	1798,7	-0,4	0,7	54			
		ɛ	551,7	1734	0,3	0,5				
		a	660,6	1419,5	1,2	-0,1				
		ɔ	621,5	1134,3	0,9	-0,7				
		o	508,6	1072	-0,1	-0,8				
		u	508,6	929,2	-0,1	-1,1				
61	AG	i	223	2468,7	-1,5	1,4	55-	F	Sp	Sp
		e	453	2098,5	-0,2	0,8	75			
		ɛ	461	2044,7	-0,2	0,7				
		a	777,3	1496	1,5	-0,2				
		ɔ	619	1354,3	0,7	-0,5				

		o	579,3	1235,7	0,5	-0,6				
		u	350,5	698	-0,8	-1,5				
62	AZ	i	299,5	2350,5	-1,5	1,6	55-	F	Cat ♂	Sp
		e	512	2005	-0,3	0,8	75		Sp ♀	
		ɛ	653,8	1798,2	0,5	0,4				
		a	791,5	1569,7	1,3	-0,1				
		ɔ	711,6	1288,6	0,9	-0,6				
		o	554,5	1181,5	0,0	-0,9				
		u	378,8	992,7	-1,0	-1,2				
63	AM	i	376	2525,3	-1,3	1,6	55-	F	Sp	Sp
		e	489,3	2016,3	-0,7	0,7	75			
		ɛ	686,7	1954	0,4	0,6				
		a	862,3	1592,3	1,4	-0,1				
		ɔ	715	1224	0,6	-0,7				
		o	737,7	1195,7	0,7	-0,8				
		u	444	902	-1,0	-1,3				
64	EG	i	418,5	2251,5	-1,2	1,4	55-	F	Sp ♂	Sp
		e	478	1840,7	-0,7	0,7	75		Cat♀	
		ɛ	591	1801,7	0,4	0,6				
		a	732	1569,7	1,6	0,1				
		ɔ	601,7	1140	0,5	-0,7				
		o	590,3	1151,3	0,4	-0,7				
		u	444	715	-1,0	-1,5				
65	EB	i	356,2	2488,5	-1,4	1,6	55-	F	Sp	Sp
		e	570,8	1897,3	0,0	0,6	75			
		ɛ	548,7	1925,7	-0,1	0,7				
		a	785,8	1391,2	1,5	-0,2				
		ɔ	664	1129,8	0,7	-0,7				
		o	633,4	1170	0,5	-0,6				
		u	407,2	768,8	-1,1	-1,3				

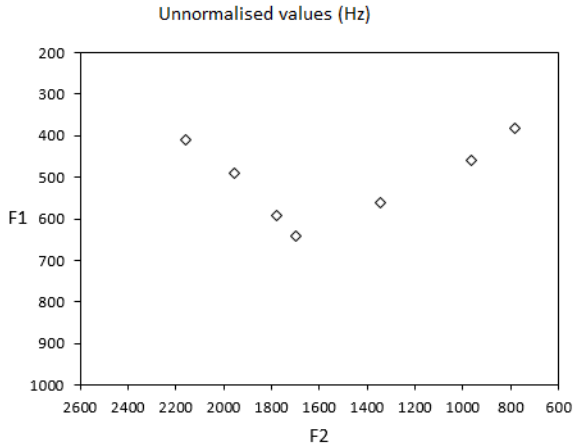
66	MCC	i	268,3	2186,3	-1,4	1,3	55-75	F	Sp	Sp
		e	540	1976,7	0,5	0,9				
		ɛ	551,3	1942,7	0,6	0,8				
		a	686,7	1439,3	1,5	-0,1				
		ɔ	461	987	-0,1	-0,9				
		o	455,3	1026,7	-0,1	-0,8				
		u	325	783	-1,0	-1,2				
67	TB	i	291	2163,7	-1,6	1,8	55-75	F	Sp	Sp
		e	520,5	1671,7	0,1	0,6				
		ɛ	579,3	1603,7	0,6	0,4				
		a	681	1377	1,3	-0,2				
		ɔ	562,7	1145,3	0,4	-0,7				
		o	534,7	1162	0,2	-0,7				
		u	359	975,7	-1,1	-1,2				
68	PT	i	257	2087,2	-1,3	1,1	55-75	F	Sp	Sp
		e	440,6	2056	-0,4	1,1				
		ɛ	590,5	1954	0,4	0,8				
		a	814,2	1504,5	1,5	-0,1				
		ɔ	681	1224	0,8	-0,7				
		o	506,3	1077,7	-0,1	-1,0				
		u	330,7	972,8	-1,0	-1,2				
69	EP	i	342	2175	-1,4	1,5	55-75	M	Sp	Sp
		e	495	1835	-0,4	0,7				
		ɛ	664	1793	0,7	0,6				
		a	743,3	1484,7	1,2	-0,1				
		ɔ	706,5	1190	1,0	-0,7				
		o	540,3	1140	-0,1	-0,8				
		u	415,7	970	-0,9	-1,2				
70	AMP	i	339,2	2058,8	-1,6	1,2	55-75	M	Sp	Sp
		e	495	1770,5	-0,1	0,5				
		ɛ	537,5	1706,8	0,3	0,4				

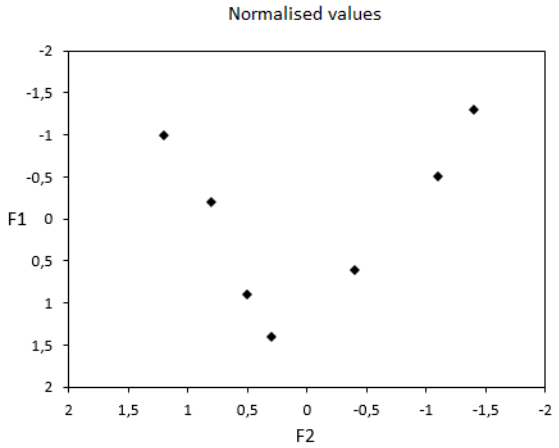
		a	643,6	1332,8	1,2	-0,5				
		ɔ	596	1224	0,8	-0,7				
		o	563	1134,2	0,5	-0,9				
		u	393	783	-1,1	-1,7				
71	JAM	i	279,7	2288,3	-0,4	1,4	55-	M	Sp	Sp
		e	466,7	1965,3	-0,2	0,8	75			
		ɛ	506,3	1937	0,0	0,7				
		a	723,5	1436,5	1,5	-0,3				
		ɔ	596	1190	0,6	-0,8				
		o	585	1195,7	0,5	-0,7				
		u	359	944,5	-1,0	-1,2				
72	J	i	342	2027,7	-1,5	1,2	55-	M	Sp	Sp
		e	579,5	1801,5	0,1	0,8	75			
		ɛ	640,2	1720,4	0,5	0,6				
		a	742,2	1509,6	1,2	0,2				
		ɔ	687,8	1302,2	0,8	-0,3				
		o	586	1048,2	0,1	-0,8				
		u	384,5	630	-1,2	-1,7				

APPENDIX E

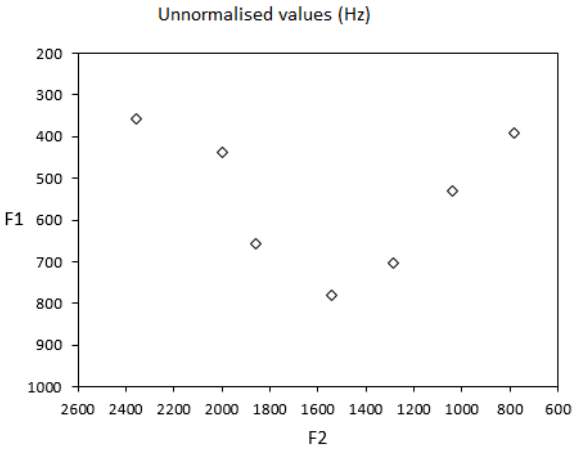
Graphs of unnormalised and normalised F1 x F2 values and social factor classification per speaker

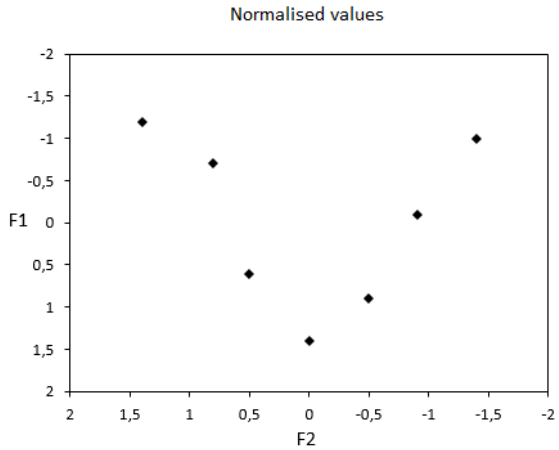
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
1	NP	+	-	+	-	-	+	-	+	-	+	-	+	+



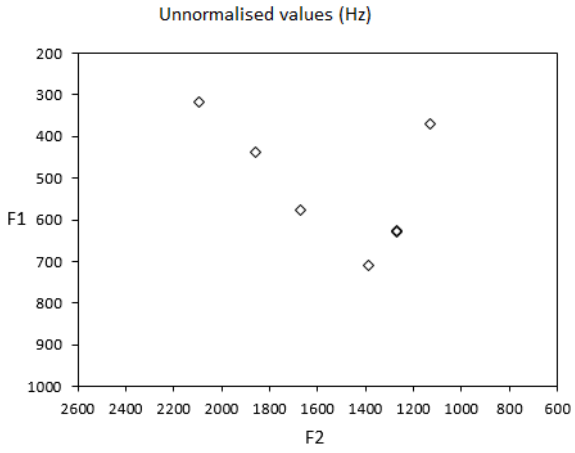


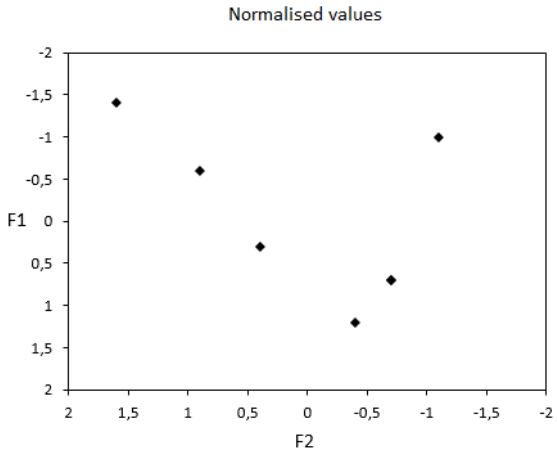
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
2	CL	+	-	+	-	-	+	-	+	-	+	-	+	+



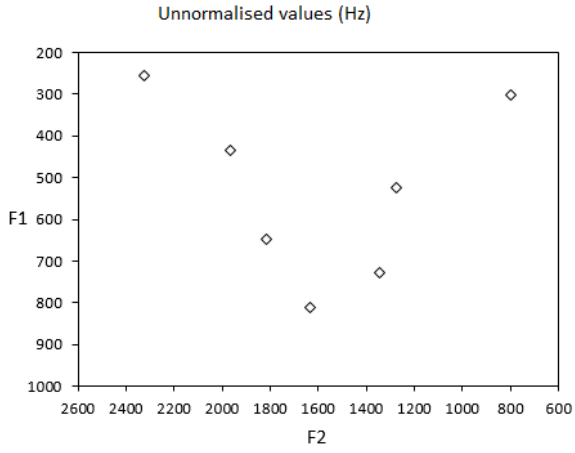


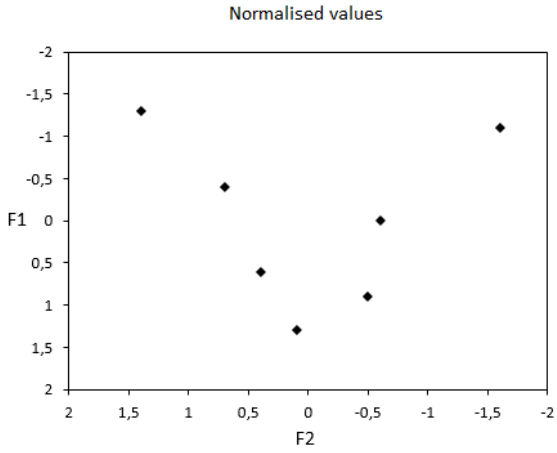
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
3	GA	+	-	+	-	-	+	-	+	-	+	-	+	-



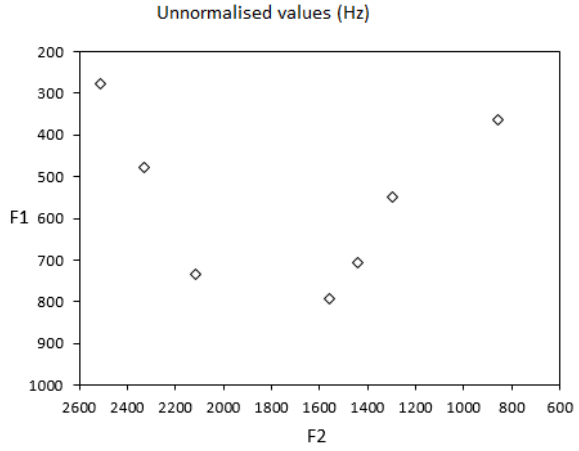


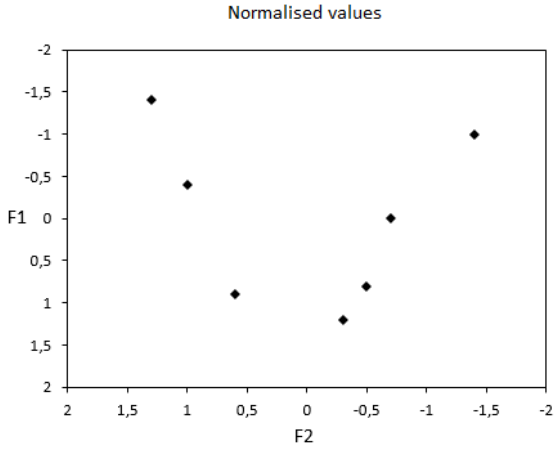
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
4	SE	+	-	+	-	-	-	-	+	+	+	-	+	+



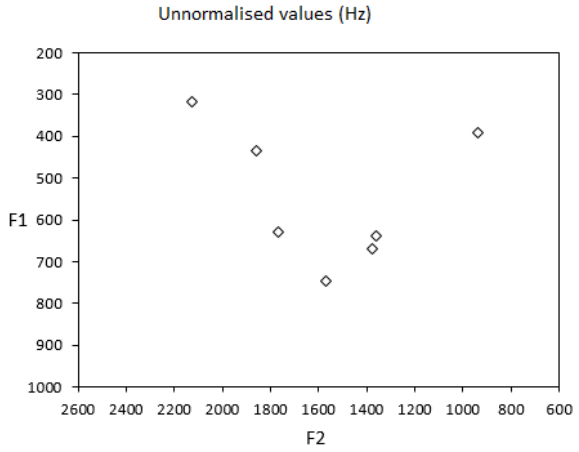


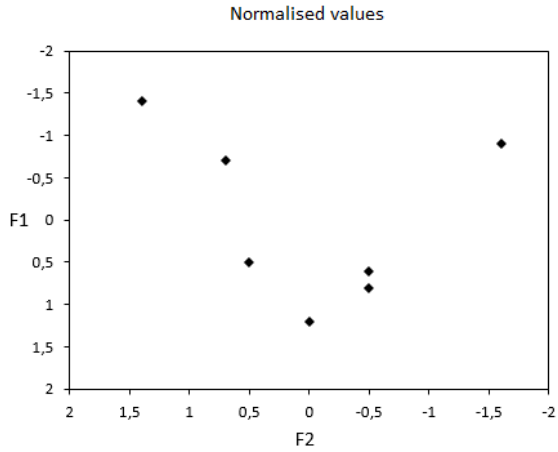
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
5	IA	+	-	+	-	-	+	-	+	-	+	-	+	+



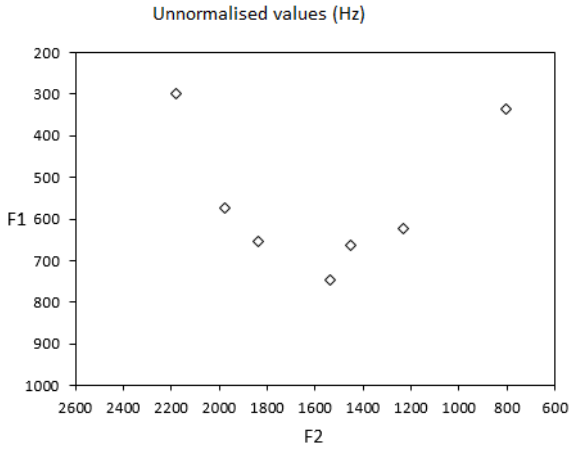


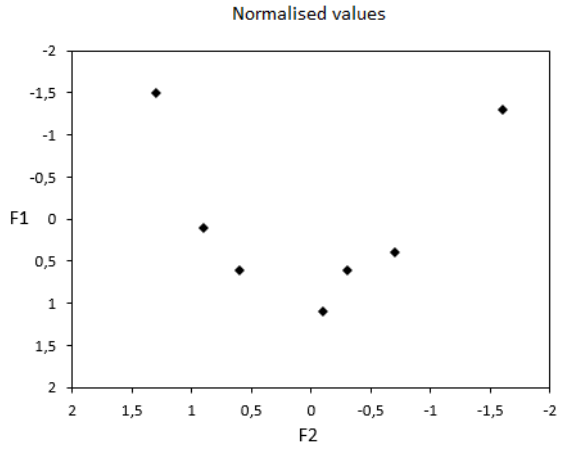
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
6	EM	+	-	+	-	-	+	+	-	-	+	-	+	-



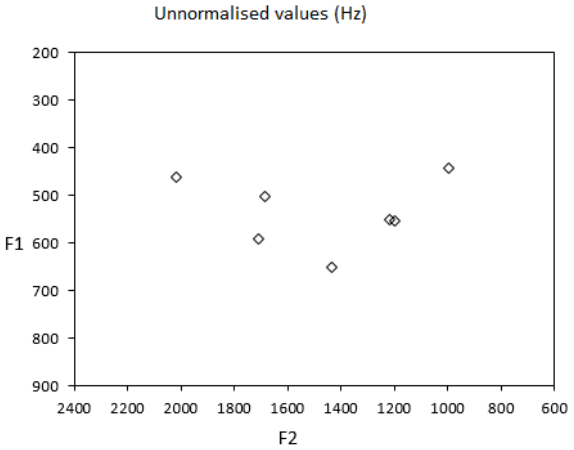


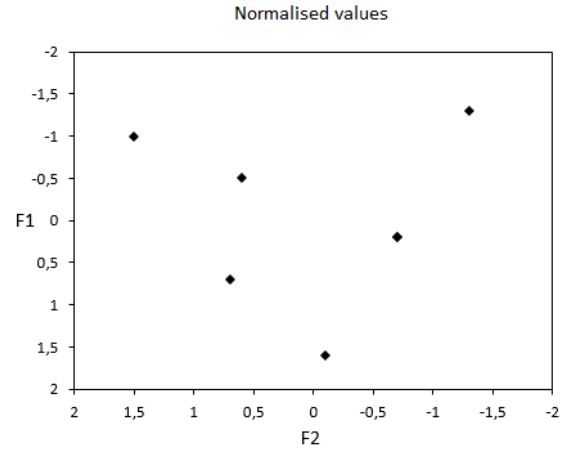
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
7	JP	+	-	+	-	-	+	-	+	-	+	-	+	-



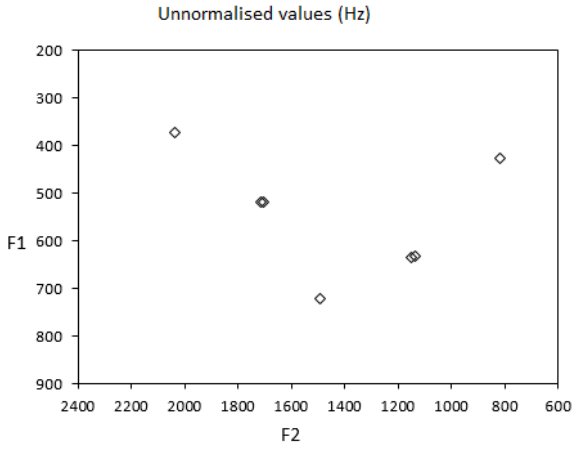


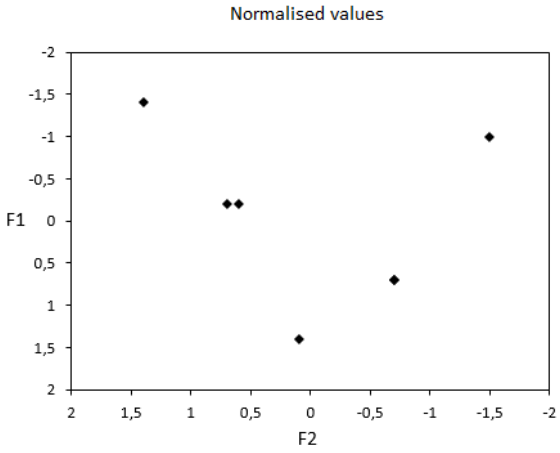
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
8	HP	-	+	+	-	-	+	-	+	-	+	-	+	-



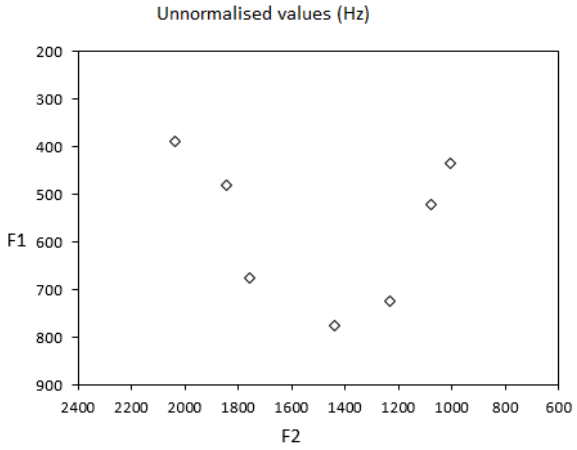


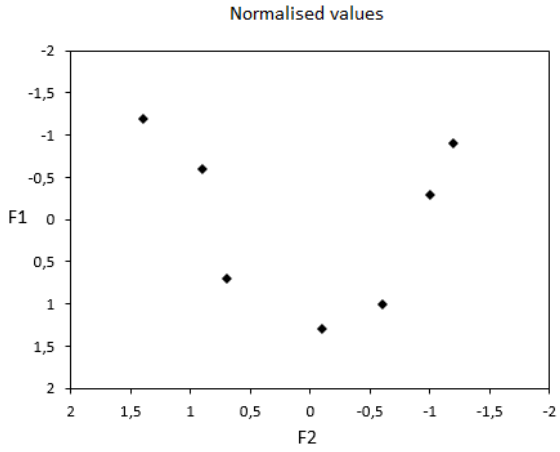
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
9	AV	-	+	+	-	-	+	-	+	-	+	-	-	-



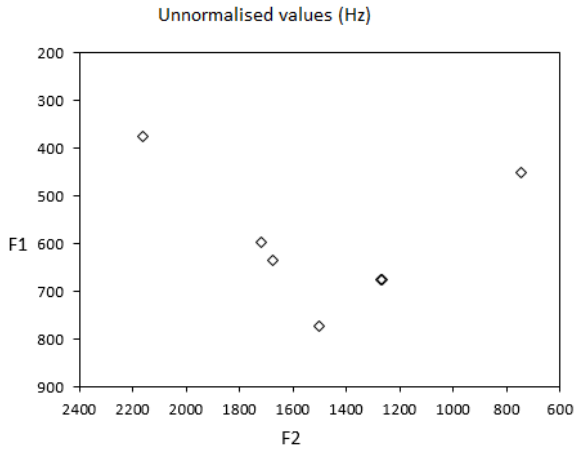


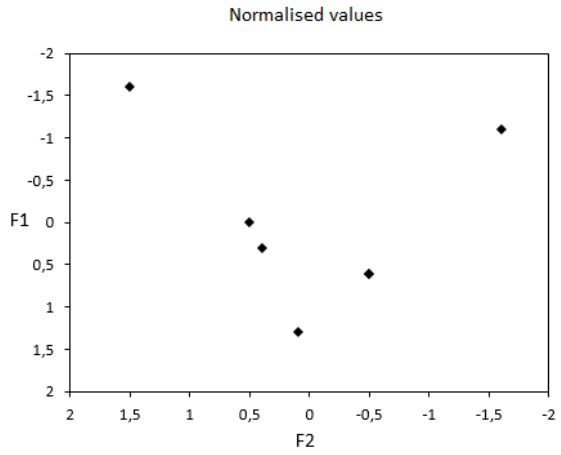
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
10	DR	-	+	+	-	-	+	-	+	-	+	-	+	+



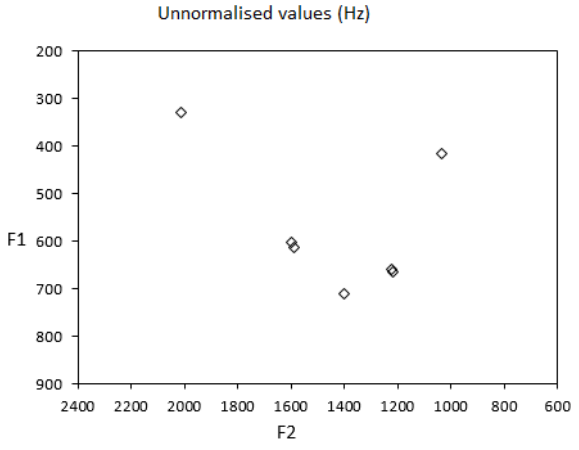


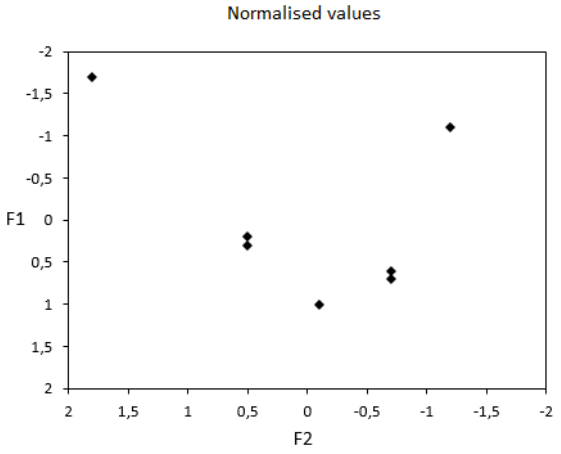
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
11	JVA	-	+	+	-	-	+	-	+	-	+	-	-	-



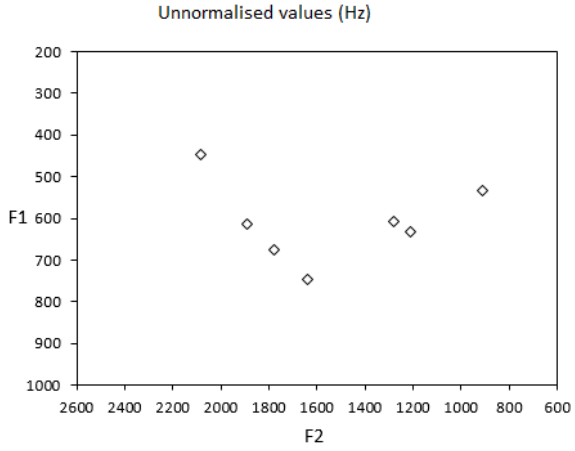


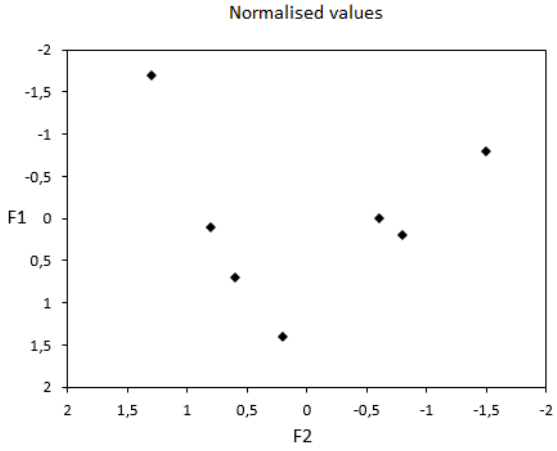
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
12	ACC	-	+	+	-	-	-	-	+	+	+	-	-	-



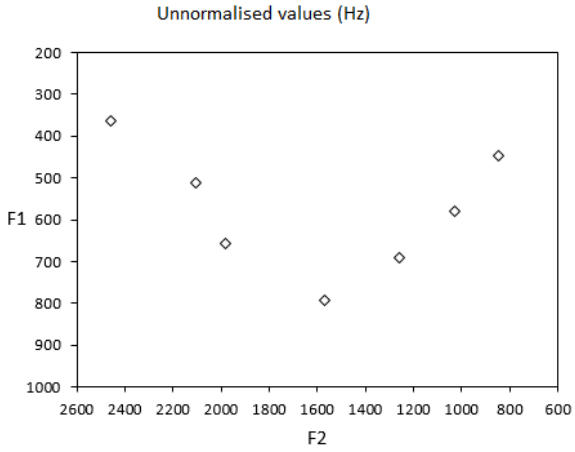


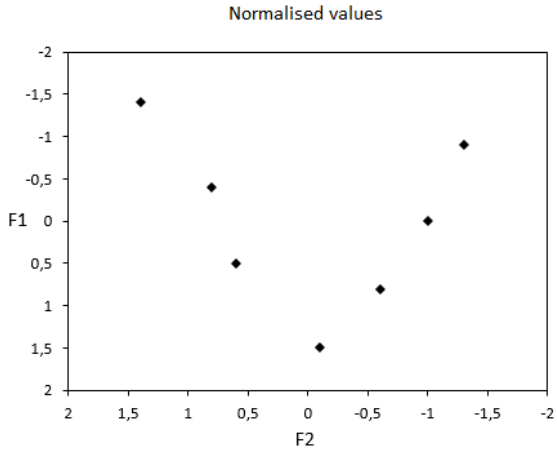
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
13	PC	+	-	-	+	-	+	-	+	-	+	-	+	-



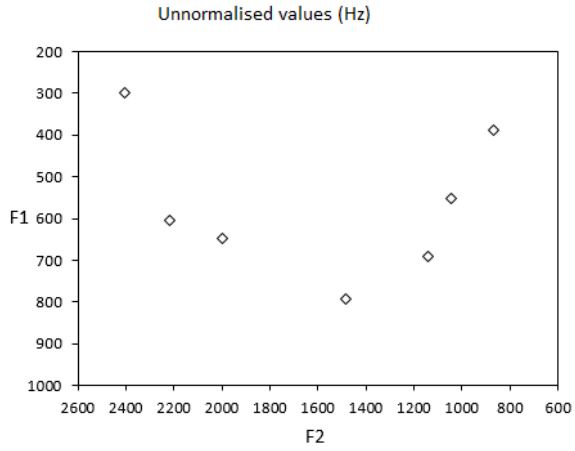


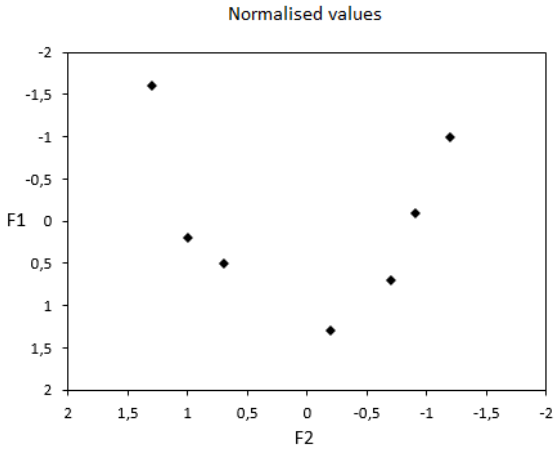
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
14	S	+	-	-	+	-	+	-	+	-	+	-	+	+



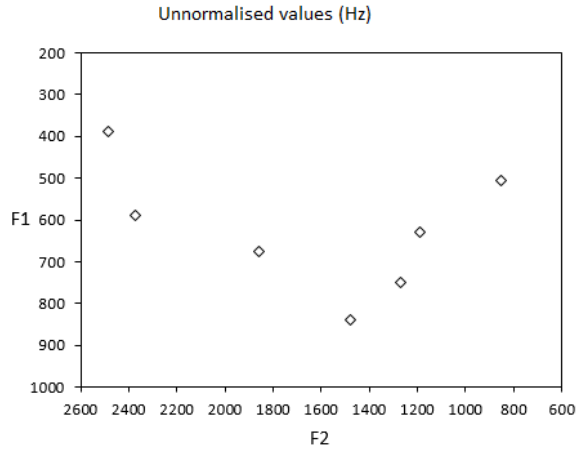


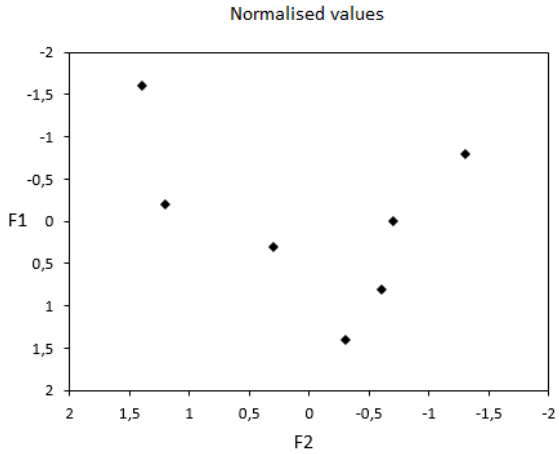
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
15	CE	+	-	-	+	-	+	-	+	-	+	-	-	+



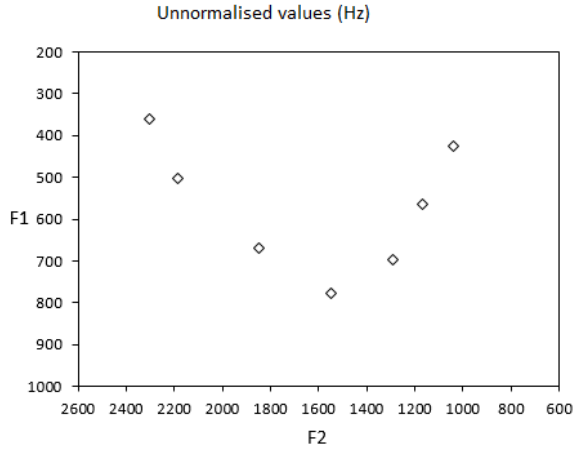


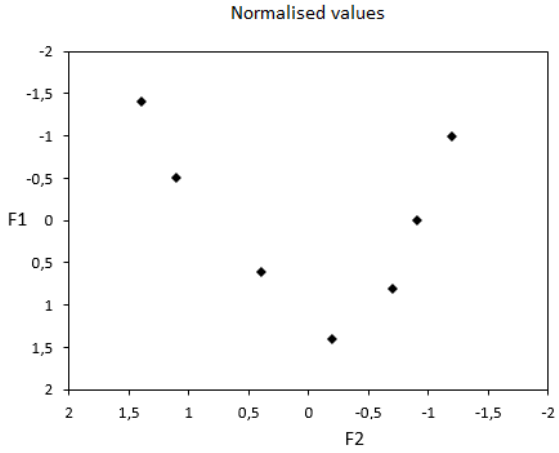
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
16	RM	+	-	-	+	-	+	-	+	-	+	-	+	+



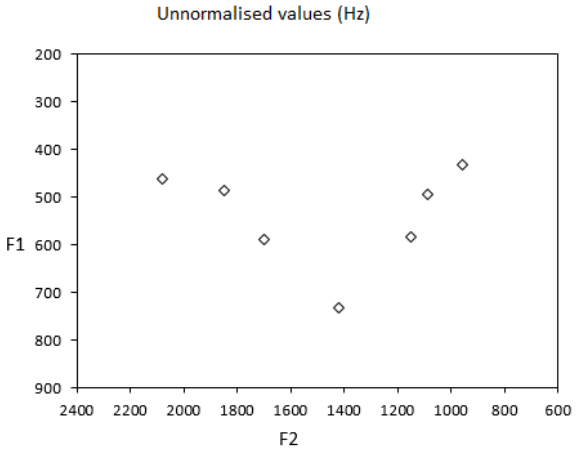


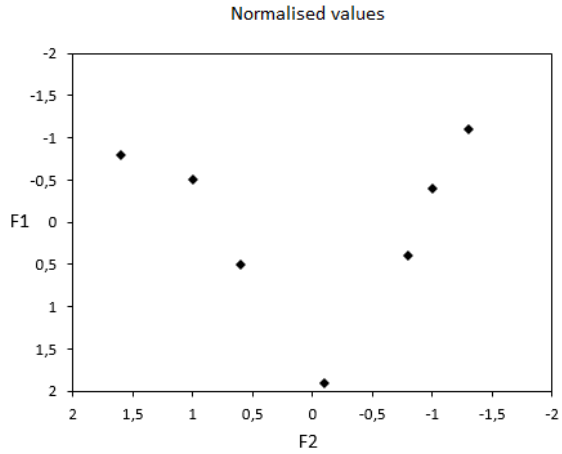
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
17	AT	+	-	-	+	-	+	+	-	-	+	-	+	+



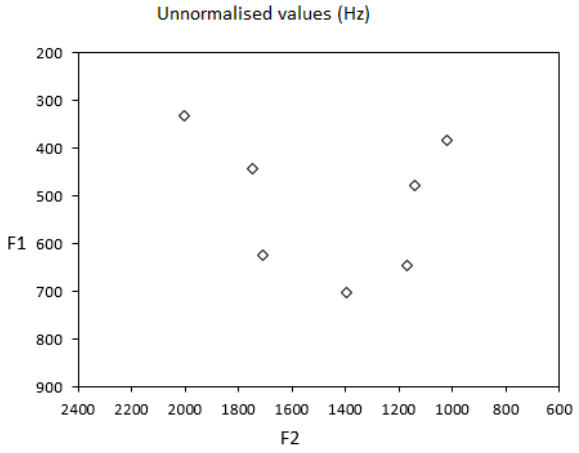


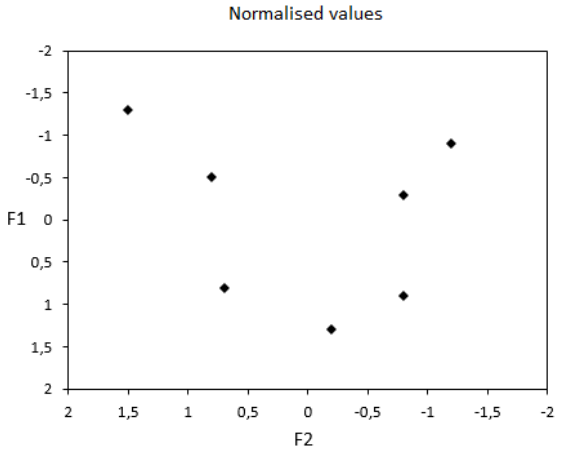
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
18	GCM	-	+	-	+	-	+	-	+	-	+	-	+	+



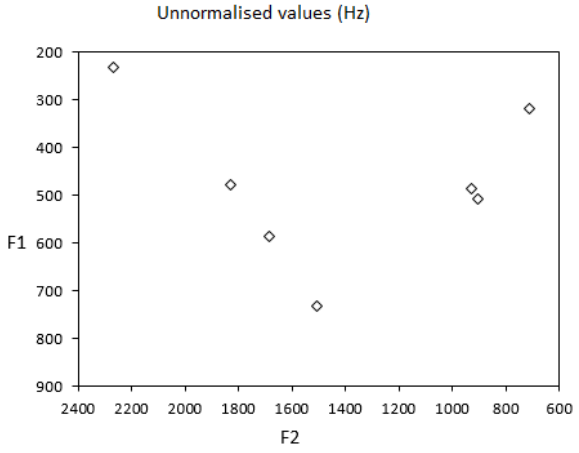


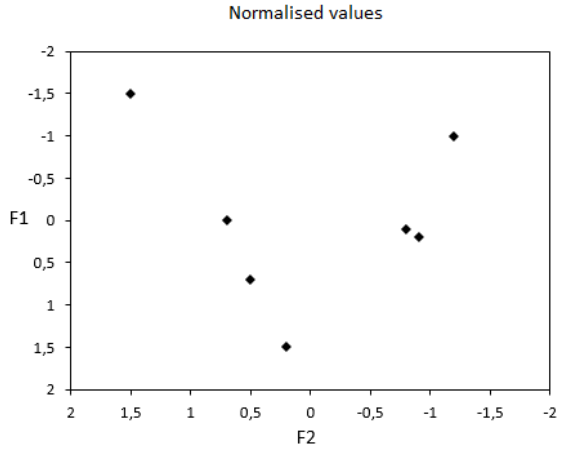
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
19	AA	-	+	-	+	-	+	-	+	-	+	-	+	+



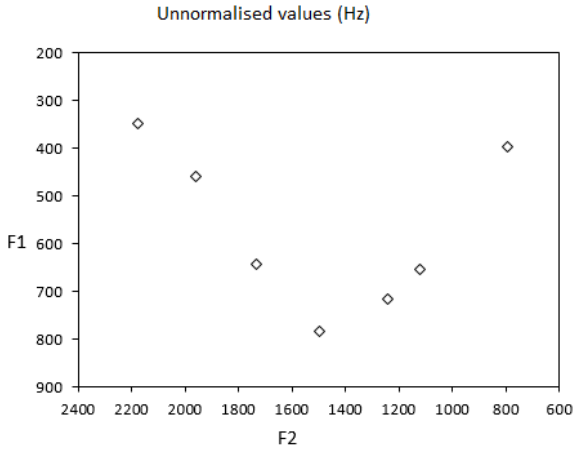


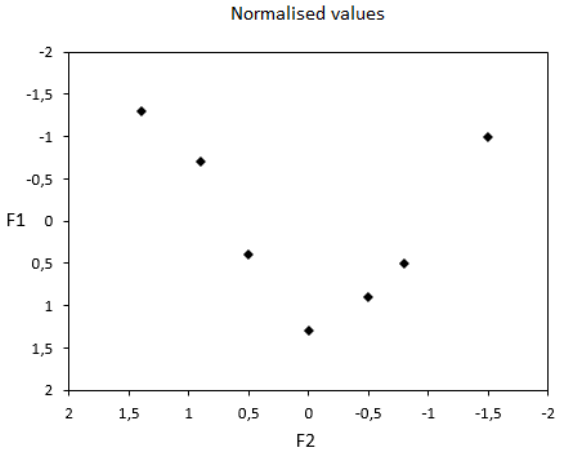
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
20	JS	-	+	-	+	-	-	-	+	+	+	-	+	-



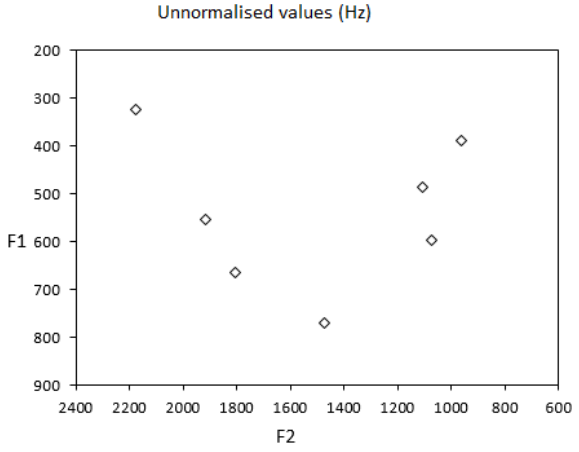


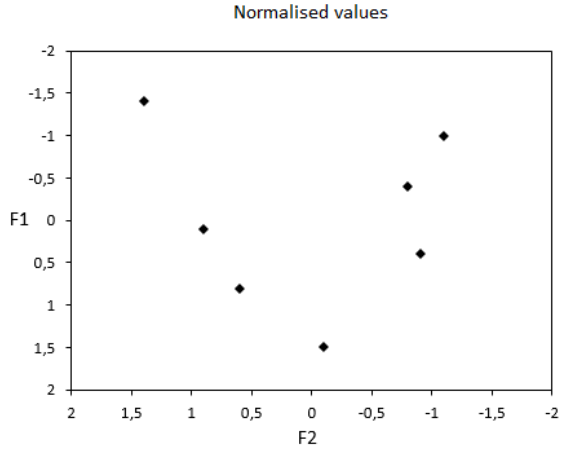
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
21	JV	-	+	-	+	-	+	-	+	-	+	-	+	+



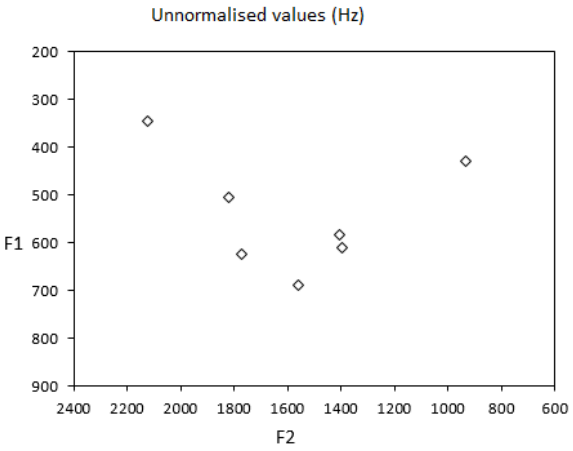


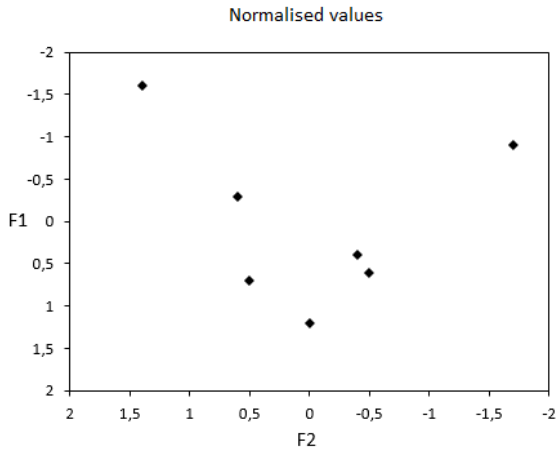
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
22	A	-	+	-	+	-	+	-	+	-	+	-	+	+



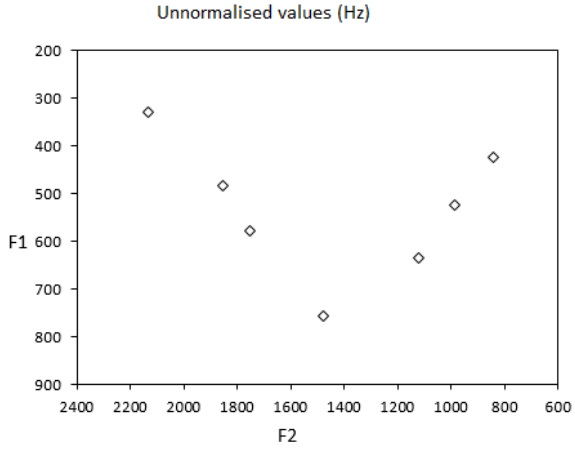


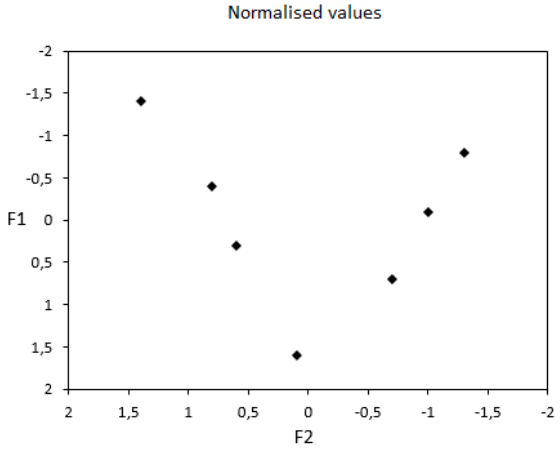
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
23	AC	-	+	-	+	-	+	-	+	-	+	-	+	-





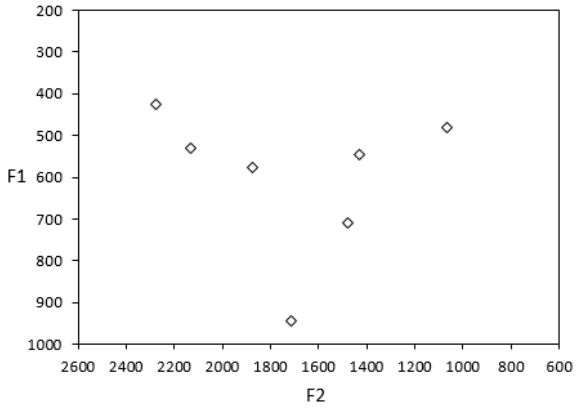
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
24	MO	-	+	-	+	-	+	-	+	-	+	-	+	+



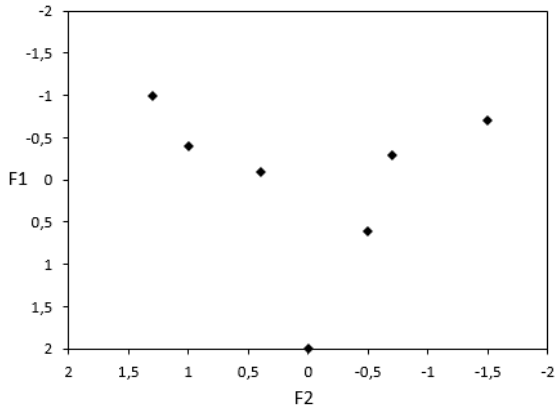


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
25	YS	+	-	-	-	+	+	-	+	-	+	-	-	+

Unnormalised values (Hz)

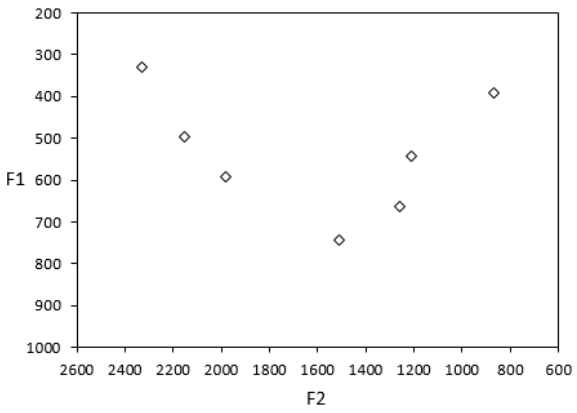


Normalised values

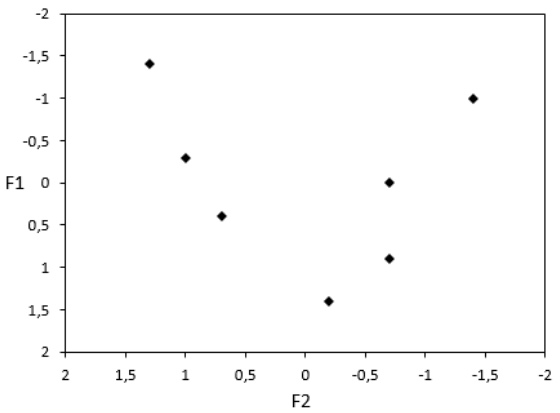


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
26	MT	+	-	-	-	+	+	-	+	-	+	-	+	+

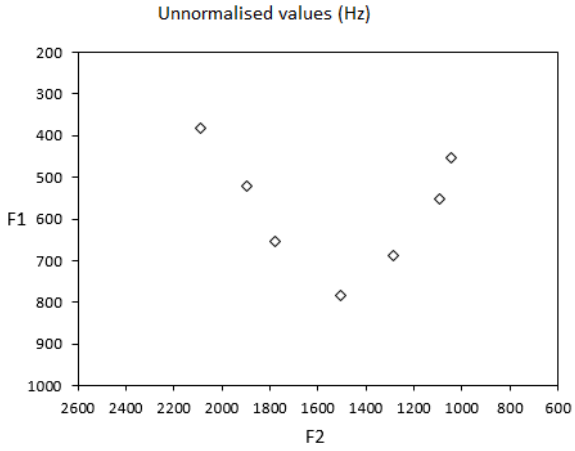
Unnormalised values (Hz)

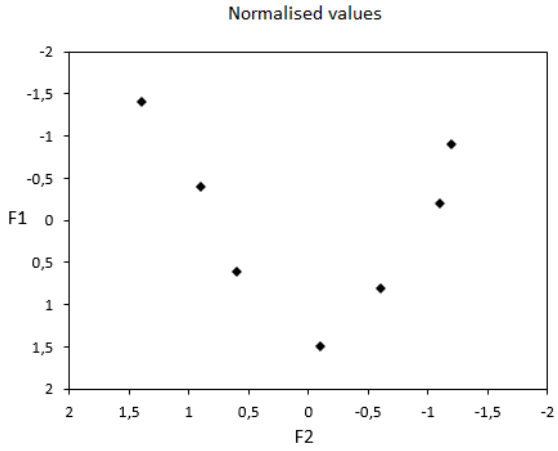


Normalised values

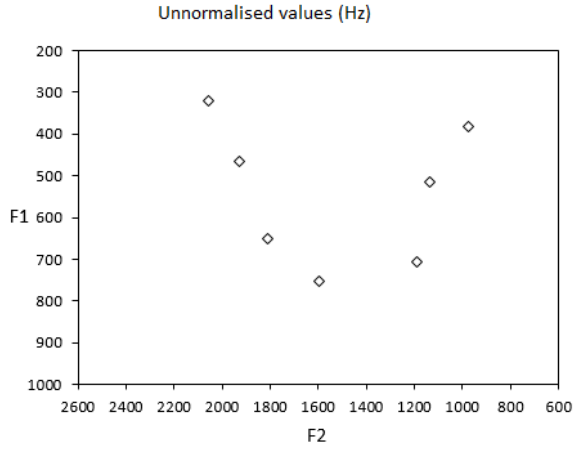


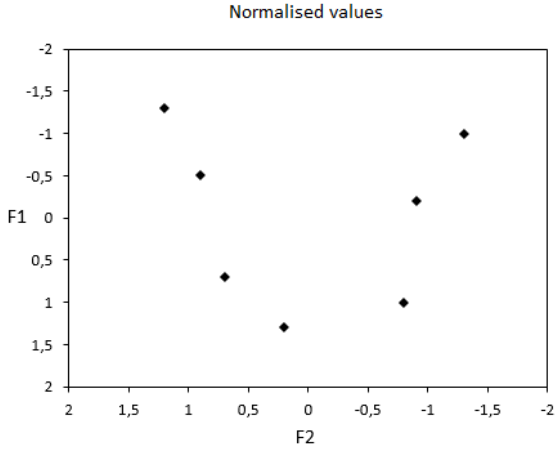
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
27	RB	+	-	-	-	+	+	-	+	-	+	-	+	+



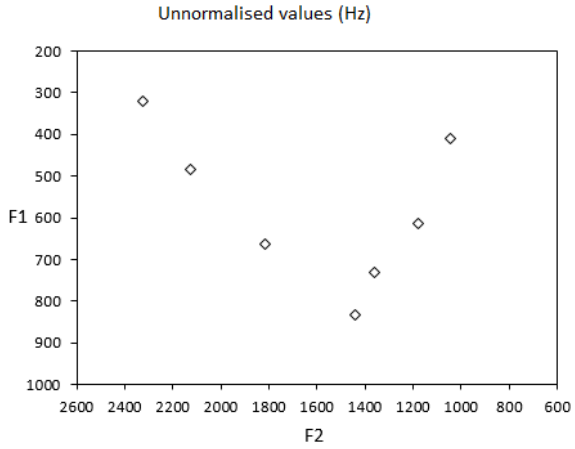


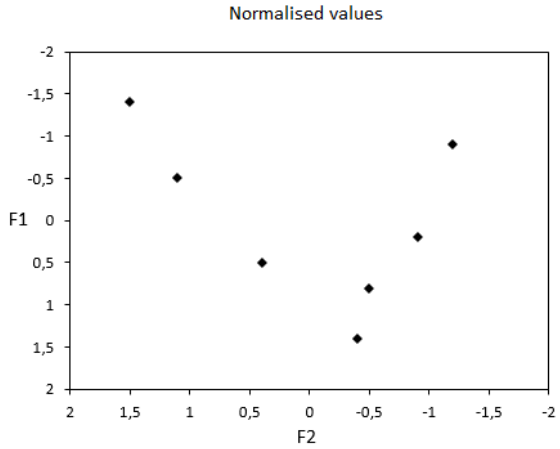
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
28	CCB	+	-	-	-	+	+	-	+	-	+	-	+	+



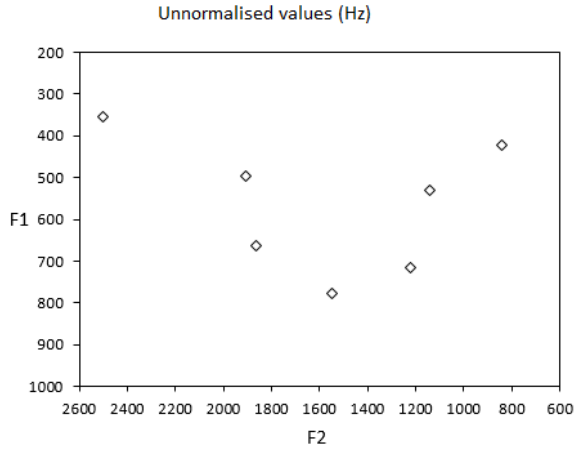


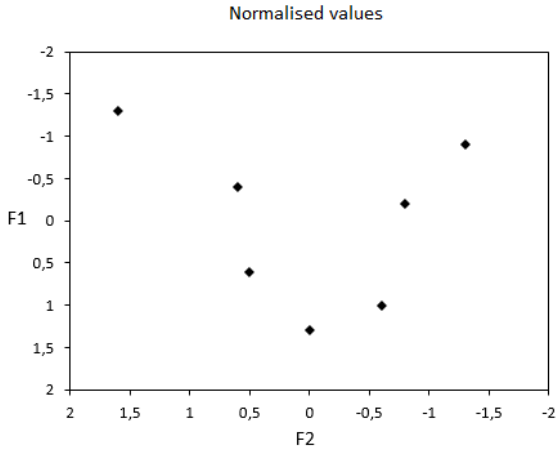
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
29	MF	+	-	-	-	+	+	-	+	-	+	-	+	+



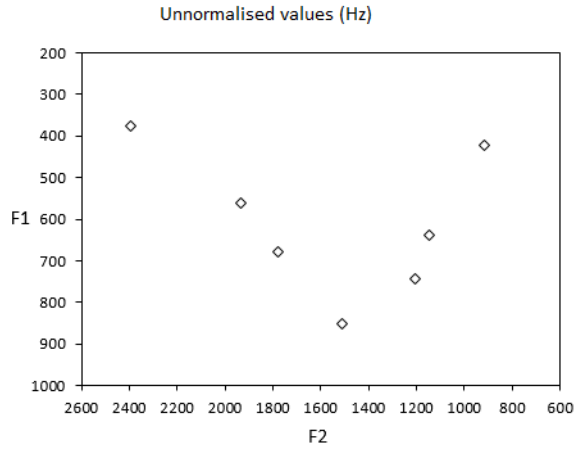


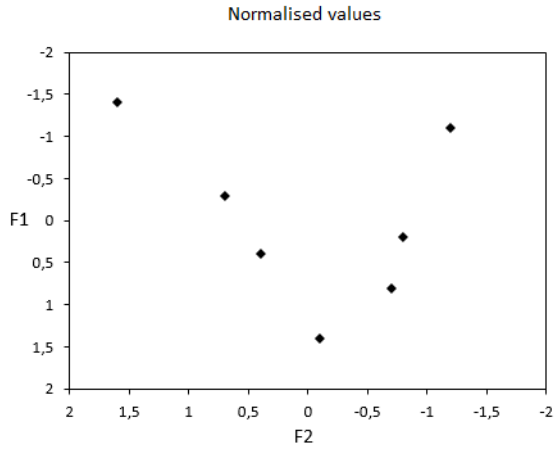
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
30	PM	+	-	-	-	+	+	-	+	-	+	-	+	+



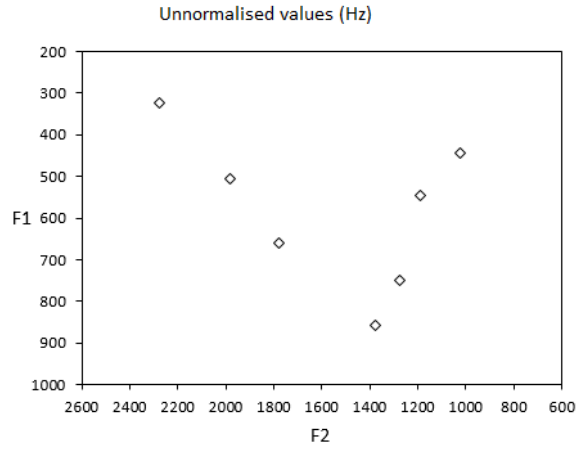


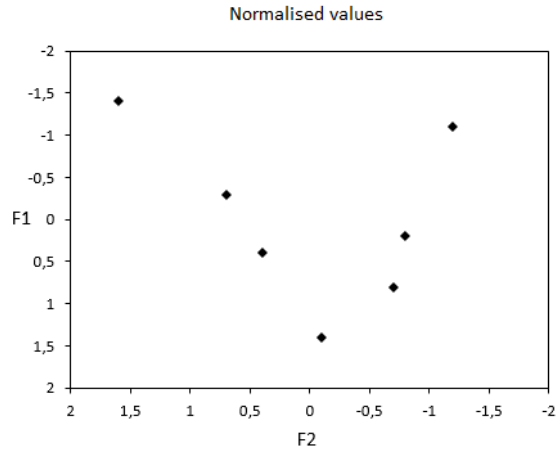
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
31	MP	+	-	-	-	+	+	+	-	-	+	-	+	+





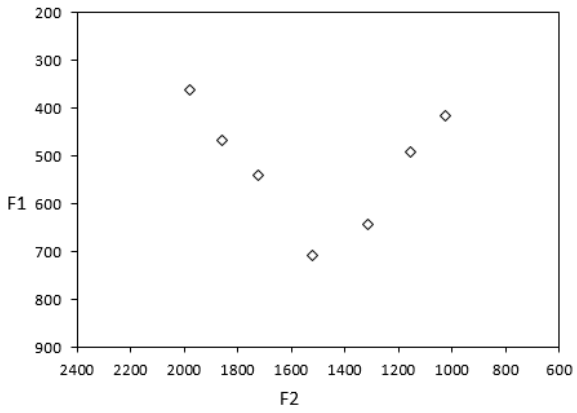
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
32	RMC	+	-	-	-	+	+	-	+	-	+	-	+	+



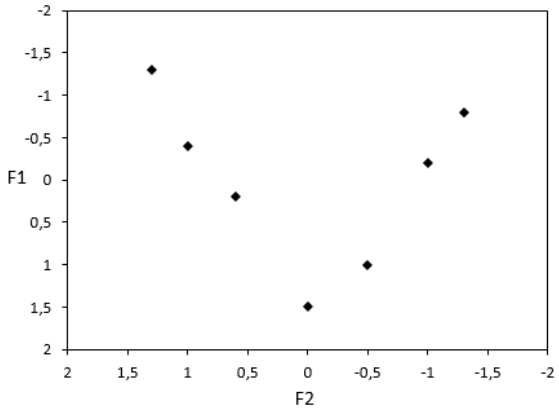


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
33	FM	-	+	-	-	+	+	-	+	-	+	-	+	+

Unnormalised values (Hz)

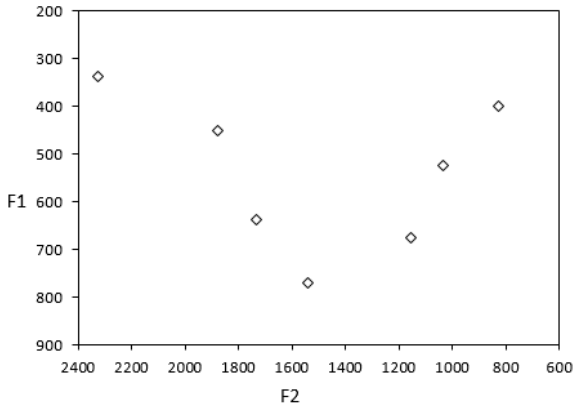


Normalised values

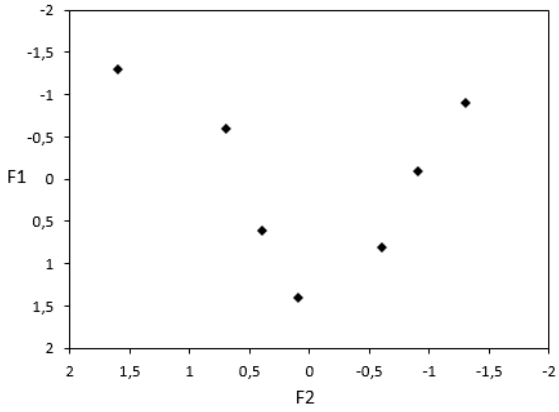


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
34	JN	-	+	-	-	+	+	-	+	-	+	-	+	+

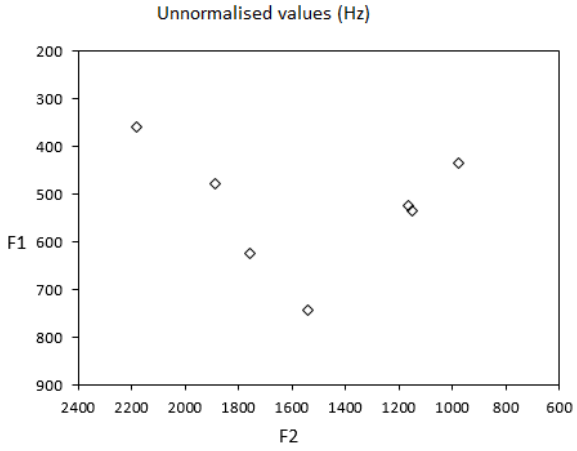
Unnormalised values (Hz)

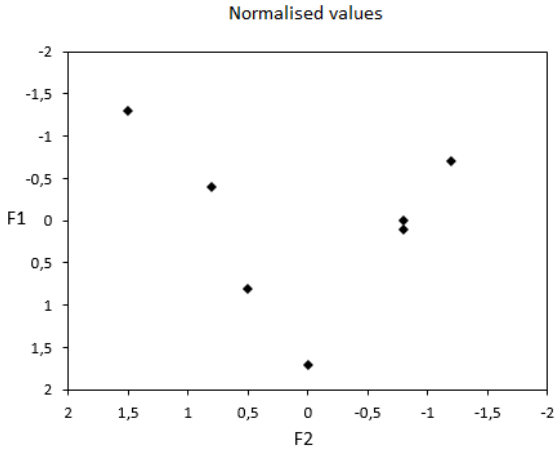


Normalised values

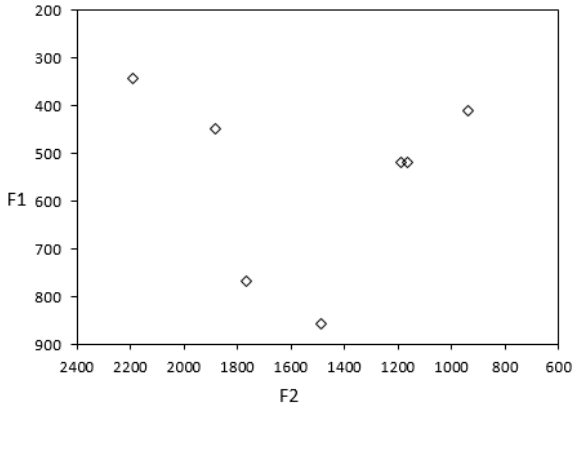


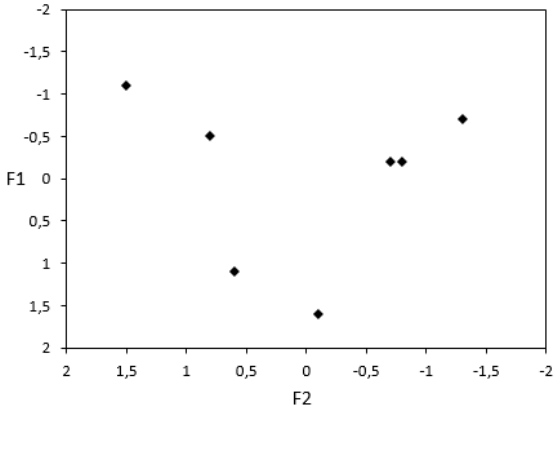
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
35	JPC	-	+	-	-	+	+	-	+	-	+	-	+	-



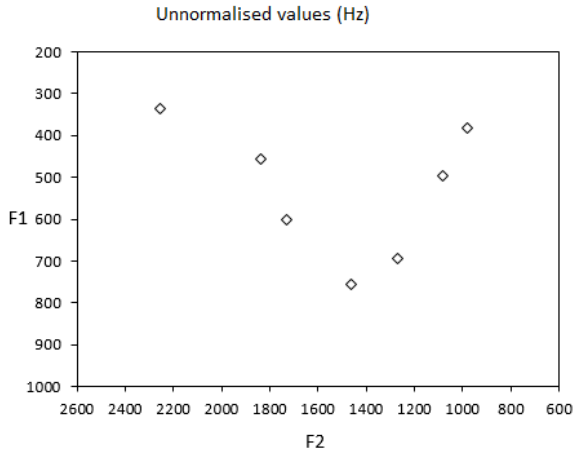


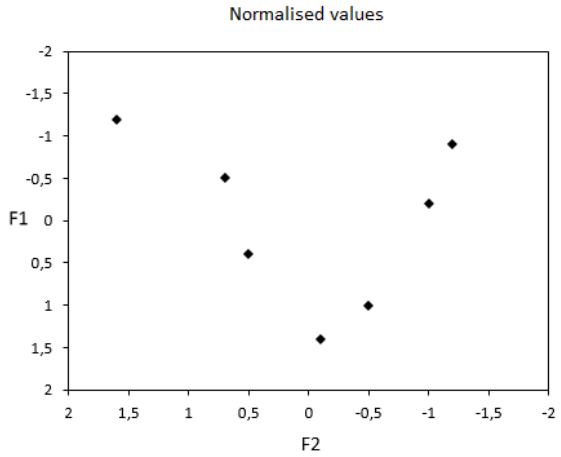
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
36	JF	-	+	-	-	+	+	-	+	-	+	-	+	-



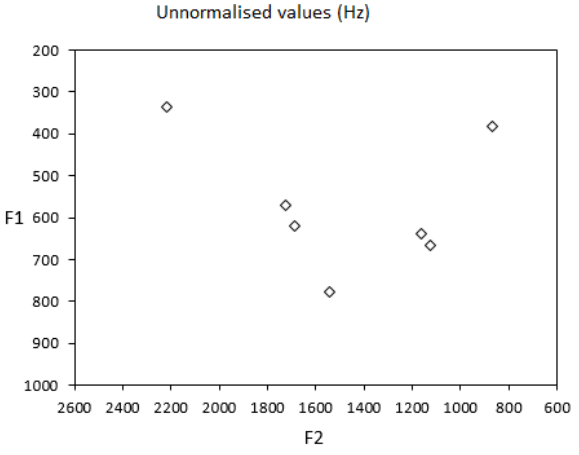


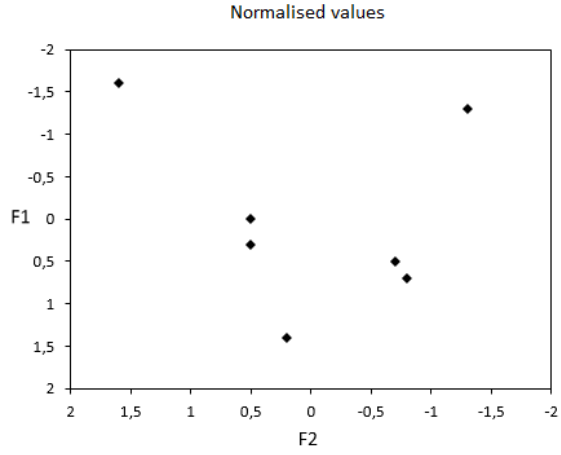
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
37	AH	+	-	+	-	-	-	+	-	+	-	+	+	+





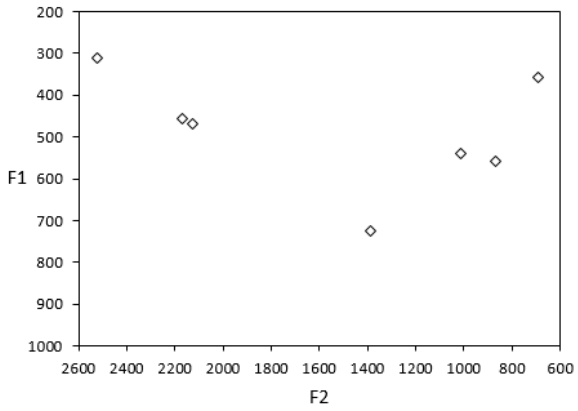
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
38	ER	+	-	+	-	-	-	+	-	+	-	+	-	-



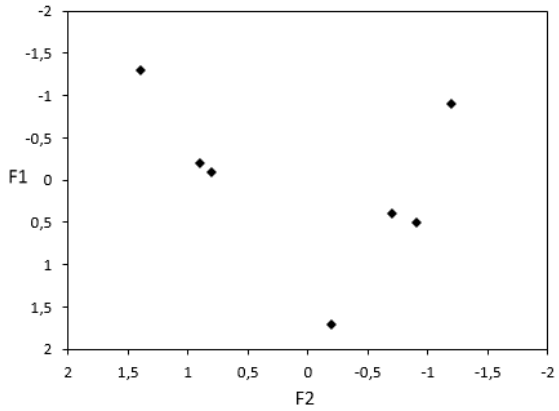


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
39	MC	+	-	+	-	-	+	+	-	-	-	+	-	-

Unnormalised values (Hz)

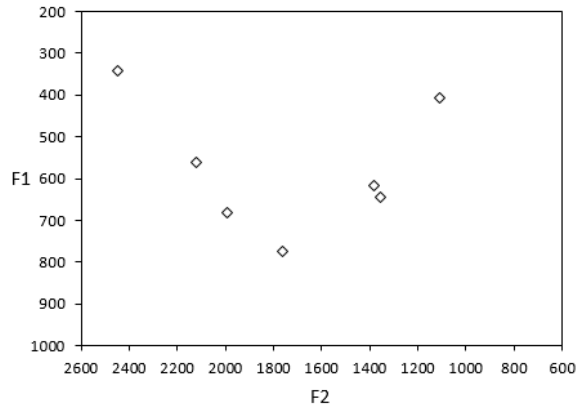


Normalised values

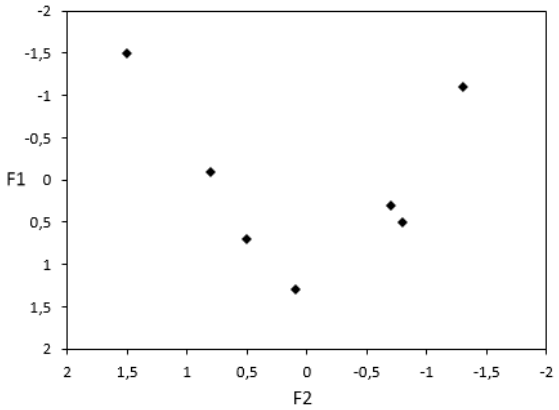


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
40	JA	+	-	+	-	-	-	+	-	+	-	+	+	-

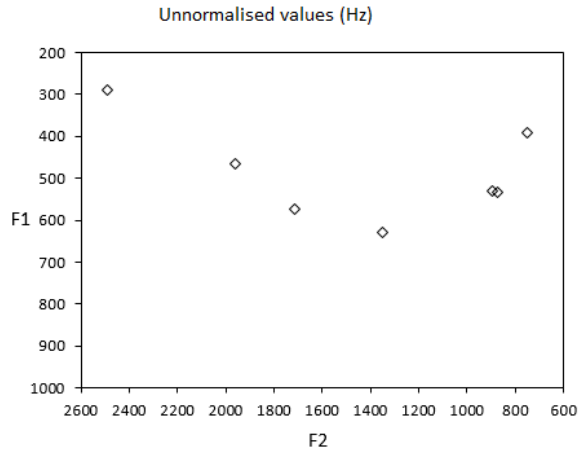
Unnormalised values (Hz)

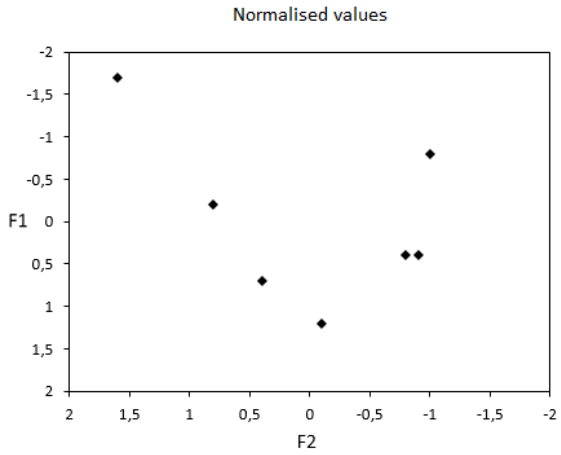


Normalised values

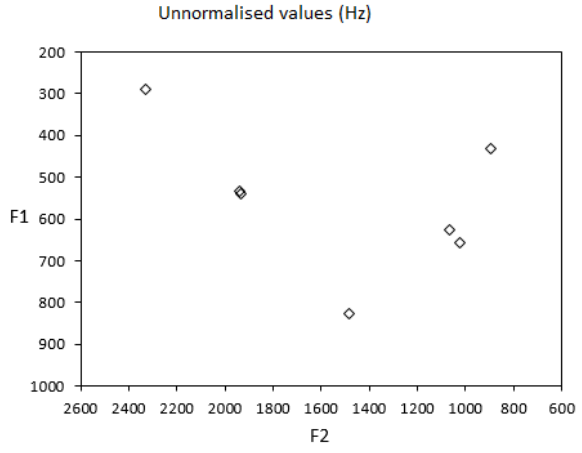


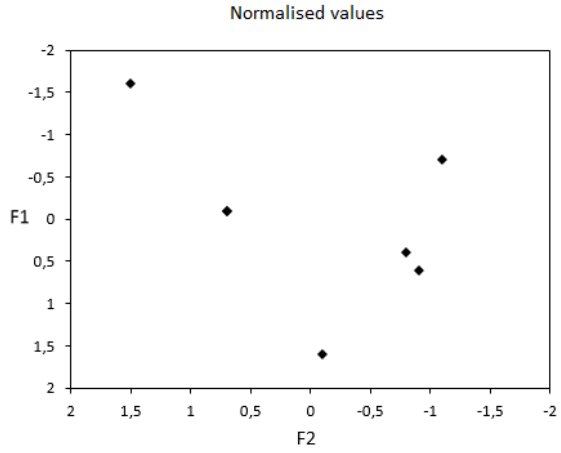
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
41	BG	+	-	+	-	-	+	-	+	-	-	+	+	-



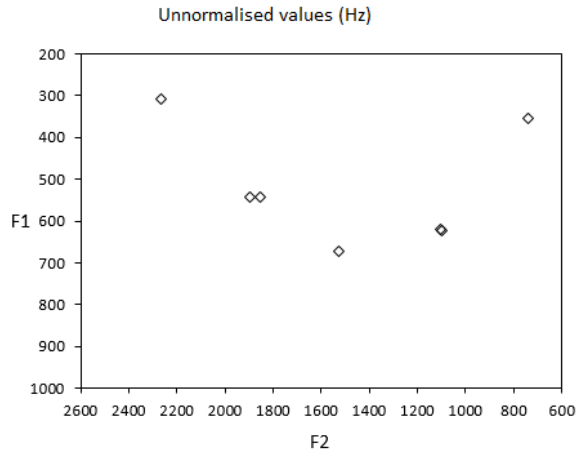


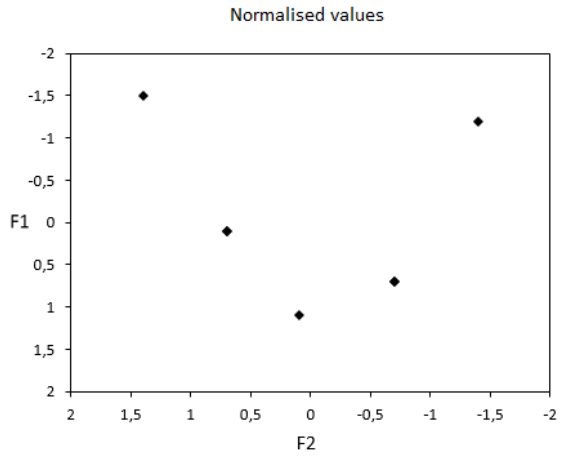
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
42	IR	+	-	+	-	-	+	+	-	-	-	+	-	-



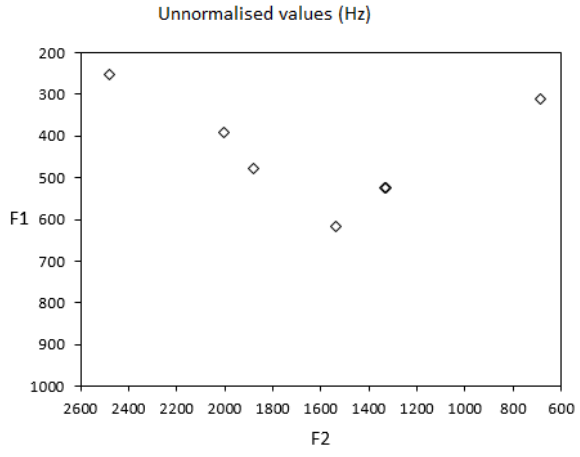


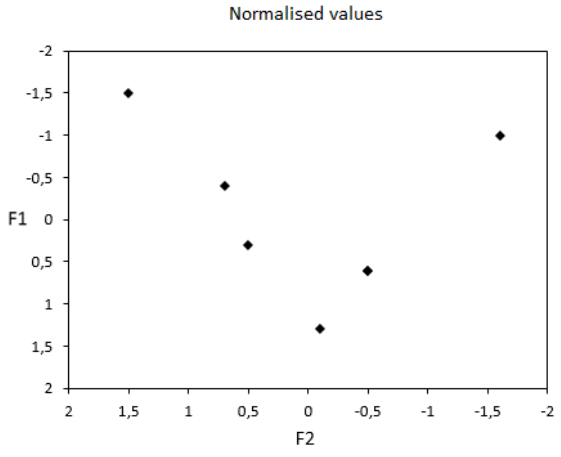
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
43	PCR	+	-	+	-	-	+	-	+	-	-	+	-	-



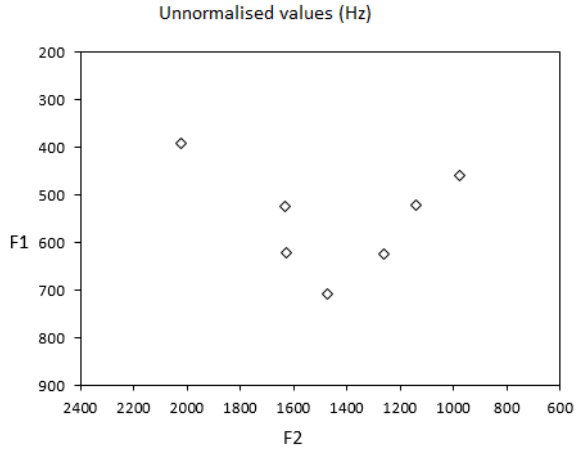


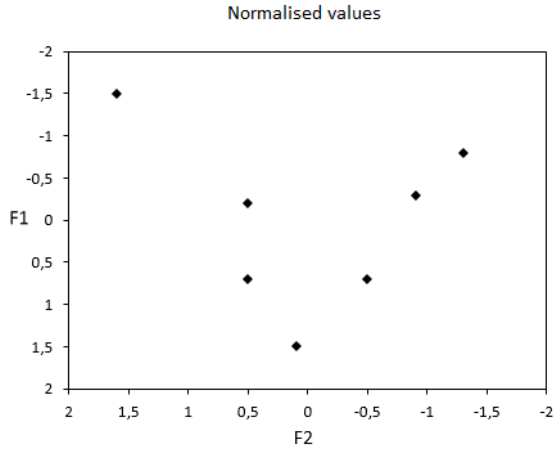
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
44	SA	+	-	+	-	-	-	+	-	+	-	+	+	-



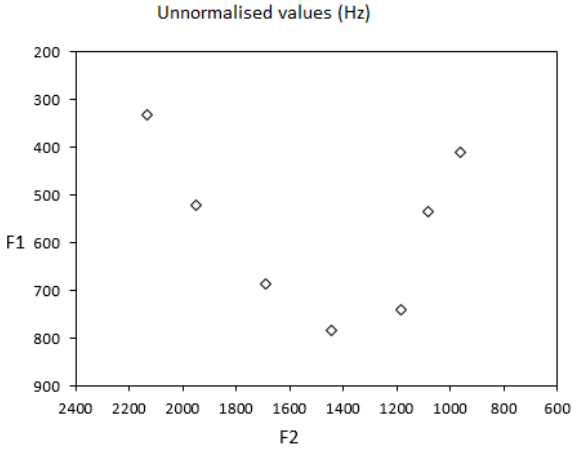


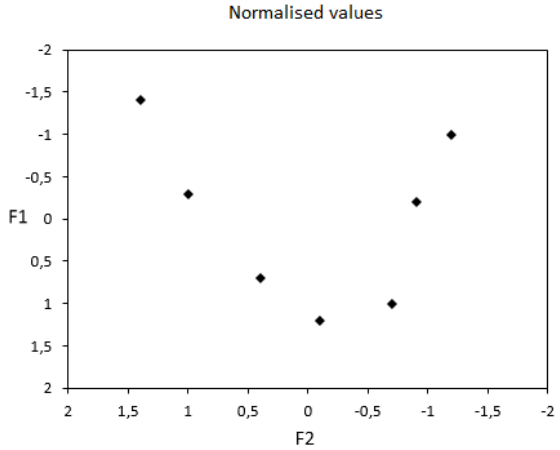
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
45	JB	-	+	+	-	-	-	+	-	+	-	+	+	+



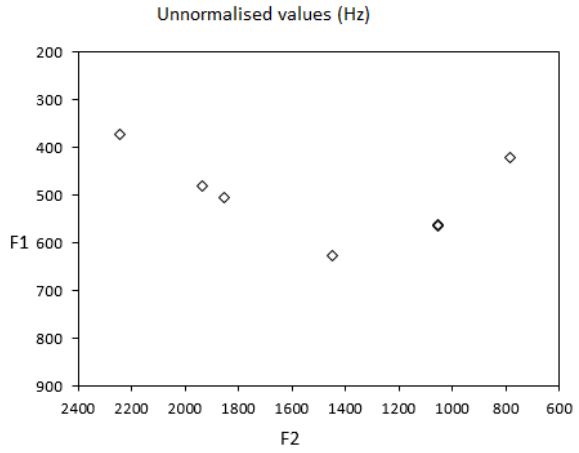


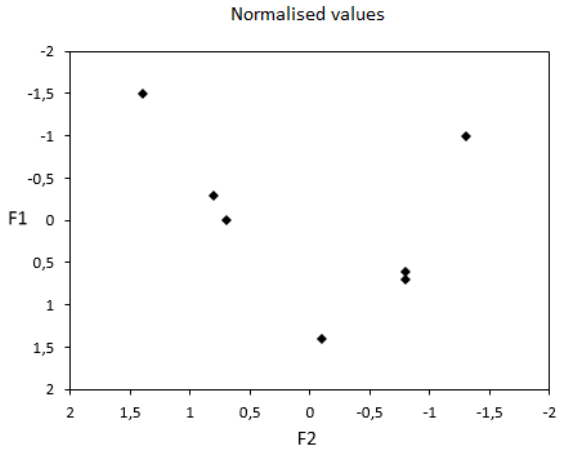
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
46	JPE	-	+	+	-	-	-	+	-	+	-	+	+	+



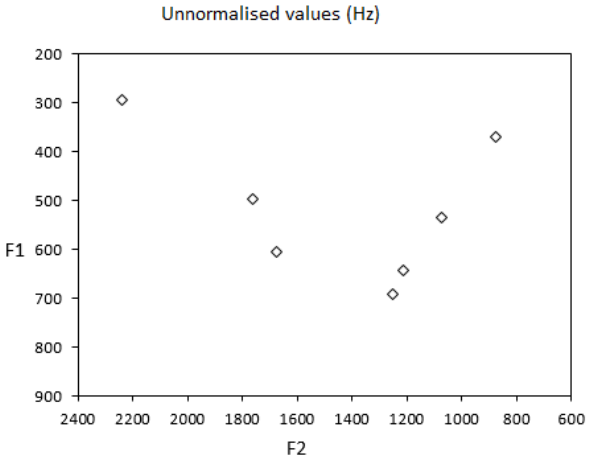


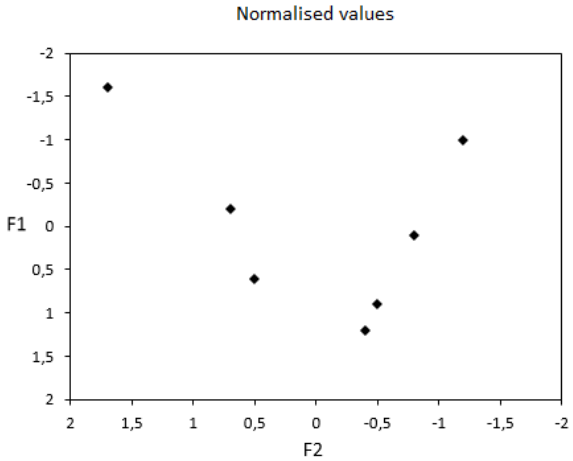
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
47	HC	-	+	+	-	-	+	-	+	-	-	+	+	-



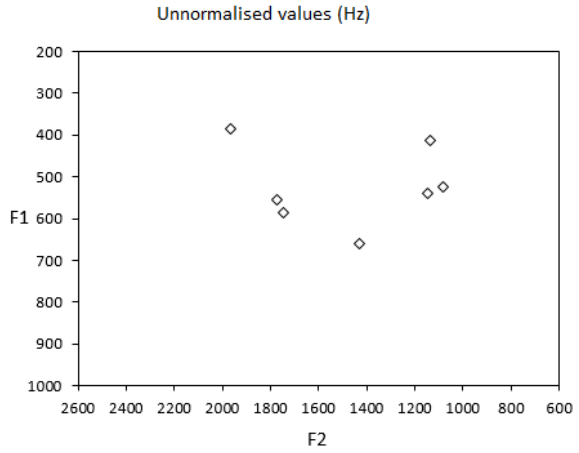


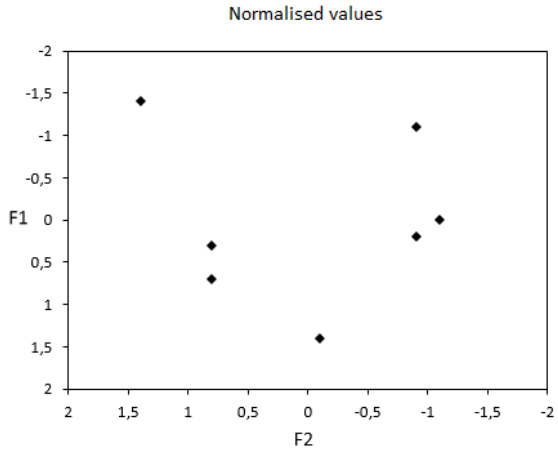
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
48	DM	-	+	+	-	-	-	+	-	+	-	+	+	+



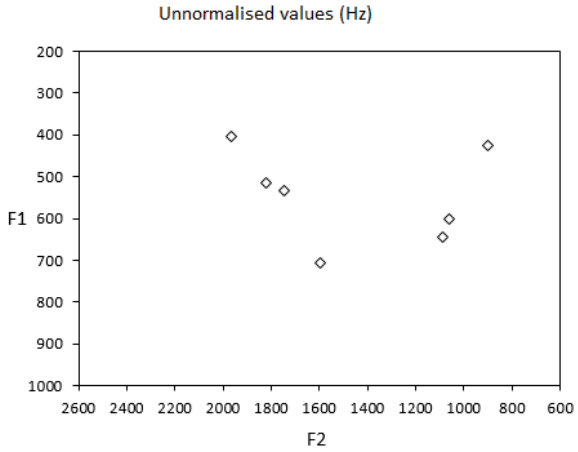


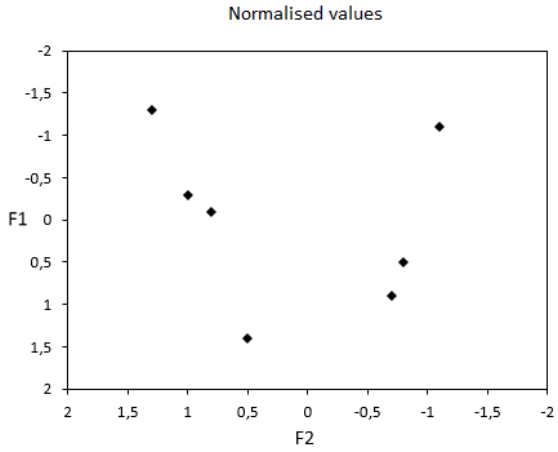
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
49	OT	+	-	-	+	-	+	+	-	-	-	+	-	-



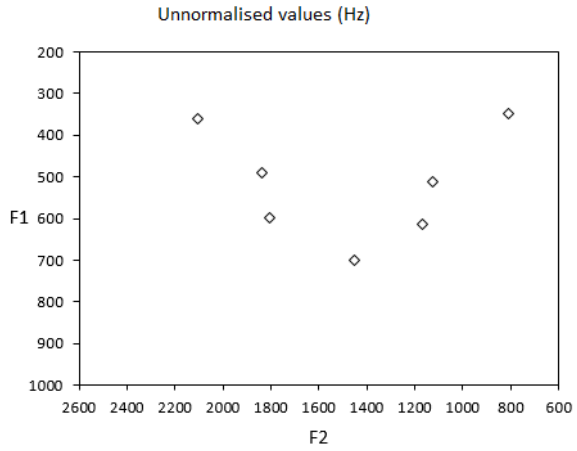


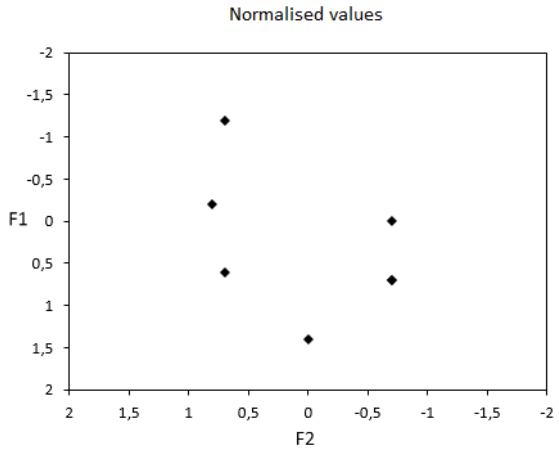
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
50	MV	+	-	-	+	-	-	+	-	+	-	+	-	-



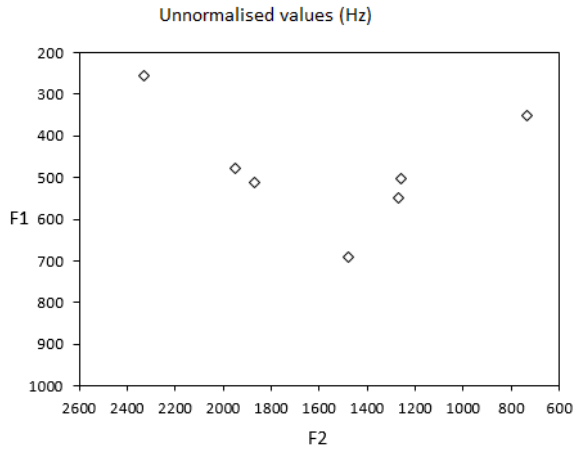


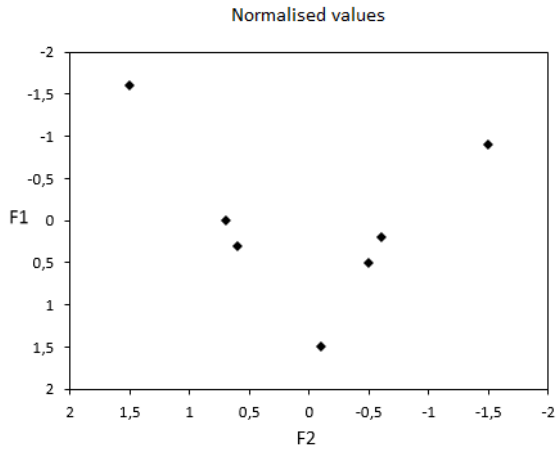
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
51	GC	+	-	-	+	-	-	+	-	+	-	+	+	+



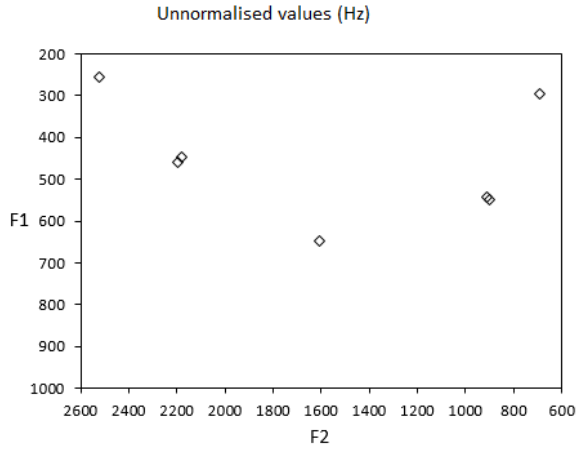


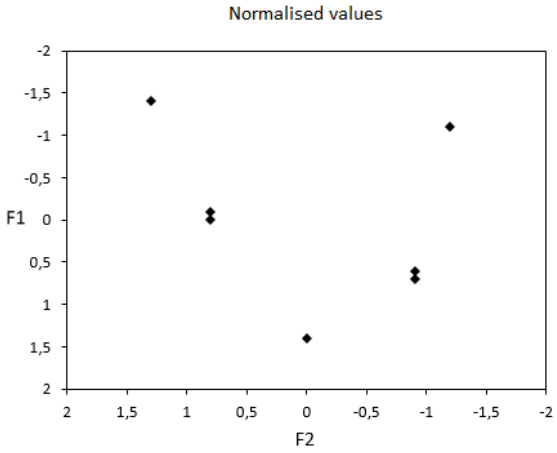
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
52	MA	+	-	-	+	-	-	+	-	+	-	+	-	-



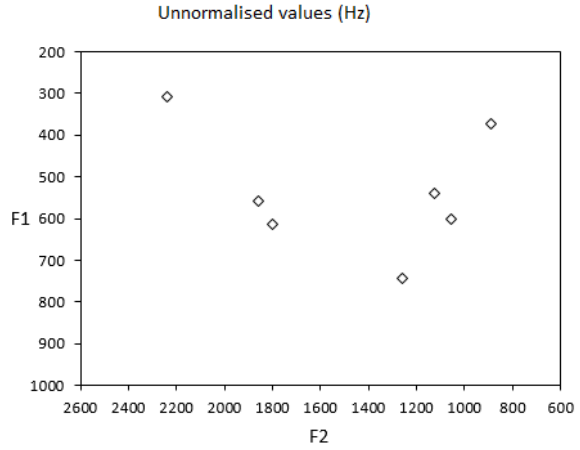


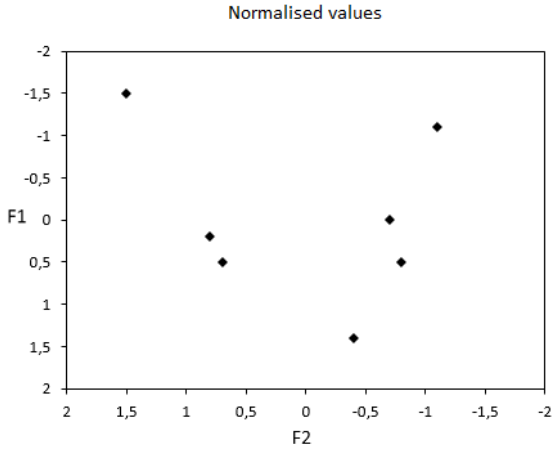
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
53	SR	+	-	-	+	-	-	-	+	+	-	+	-	-



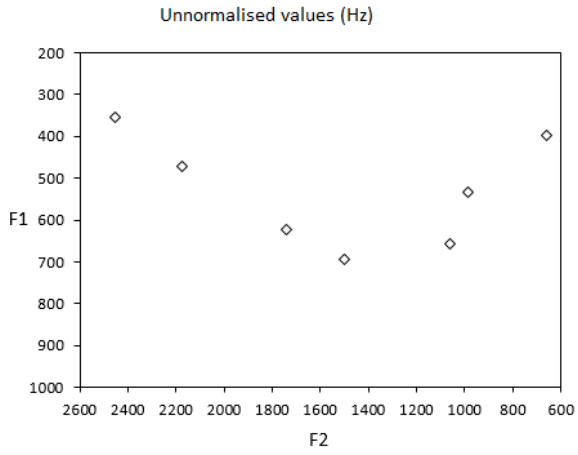


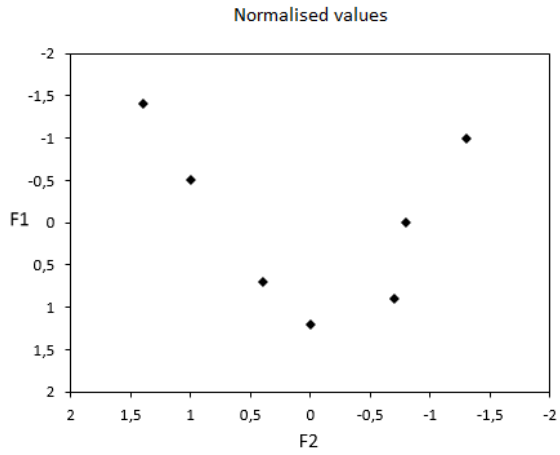
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
54	SL	+	-	-	+	-	-	+	-	+	-	+	+	+



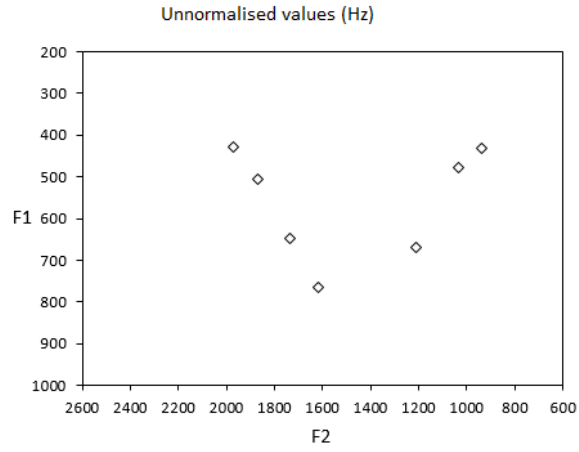


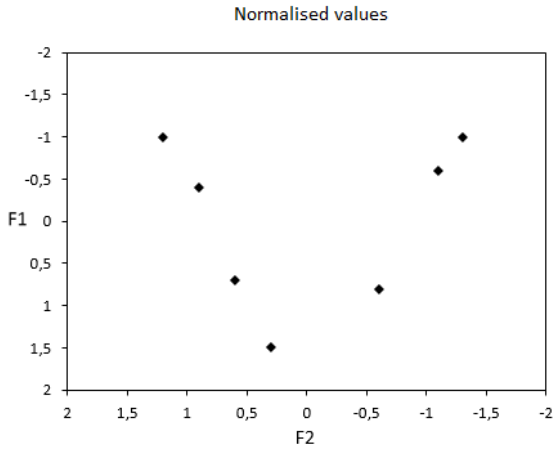
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
55	EL	+	-	-	+	-	-	+	-	+	-	+	+	+



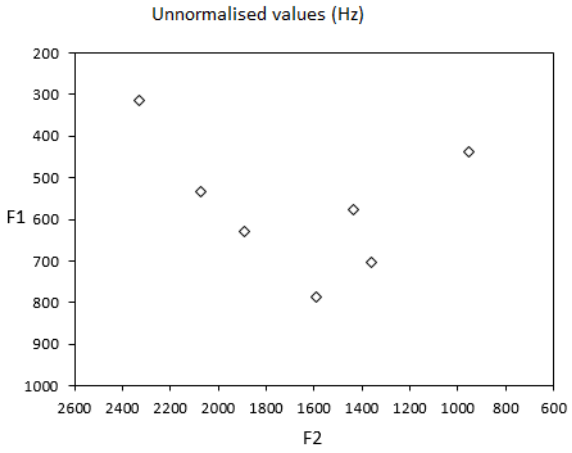


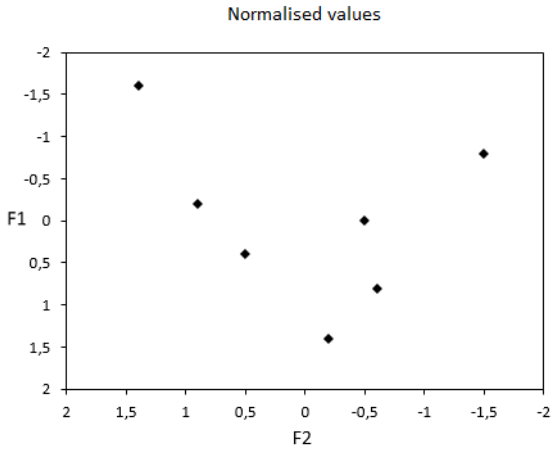
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
56	SM	+	-	-	+	-	-	-	+	+	-	+	+	+



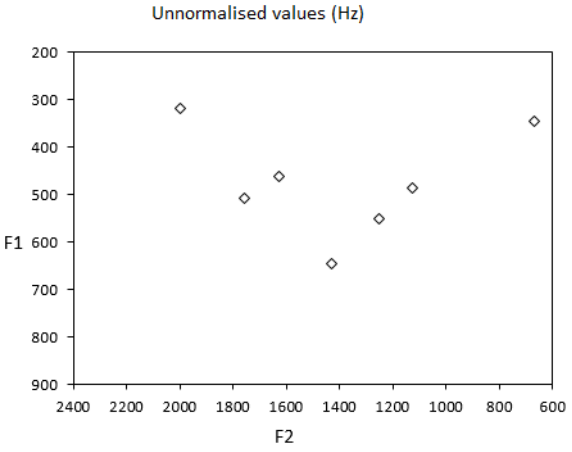


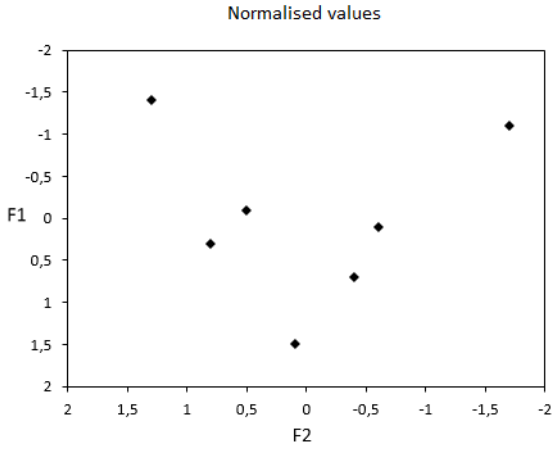
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
57	MM	+	-	-	+	-	+	-	+	-	-	+	+	+



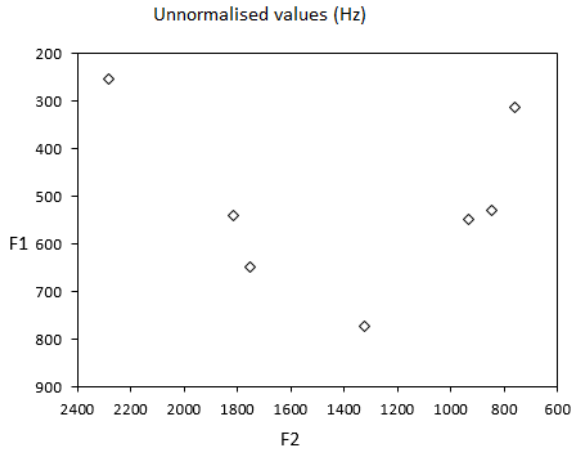


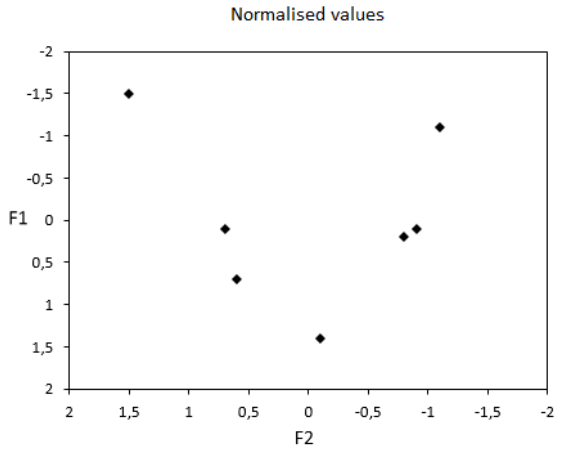
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
58	LH	-	+	-	+	-	-	-	+	+	-	+	-	+



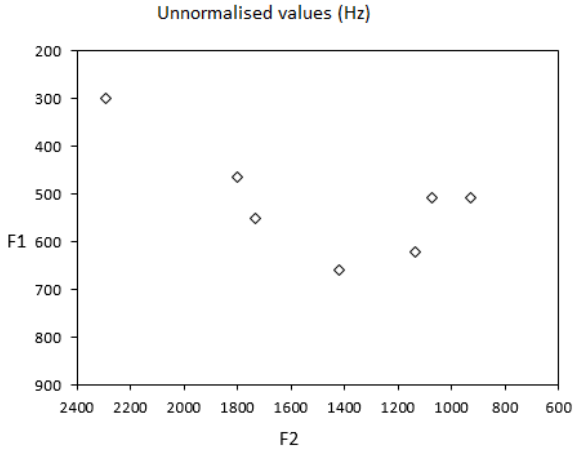


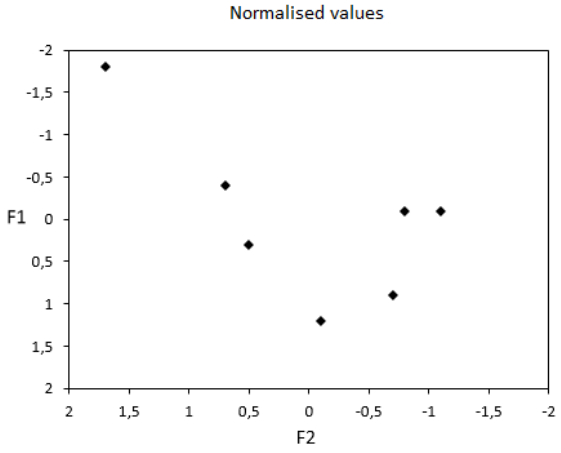
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
59	JE	-	+	-	+	-	-	+	-	+	-	+	+	-



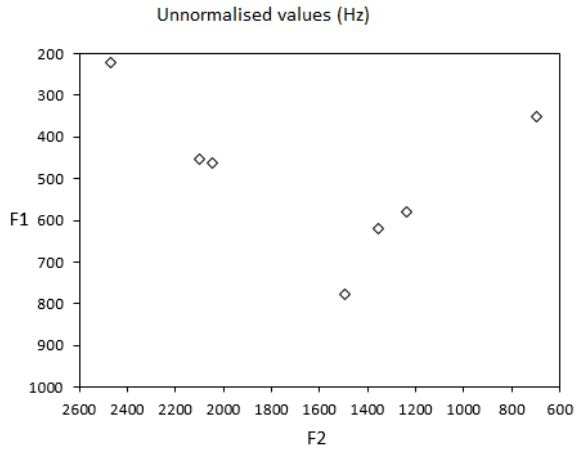


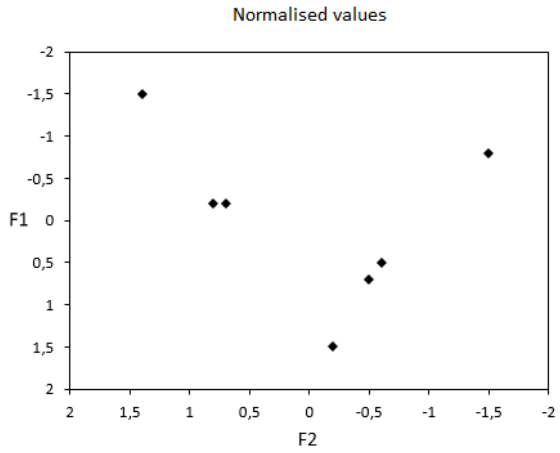
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
60	OM	-	+	-	+	-	-	+	-	+	-	+	+	+



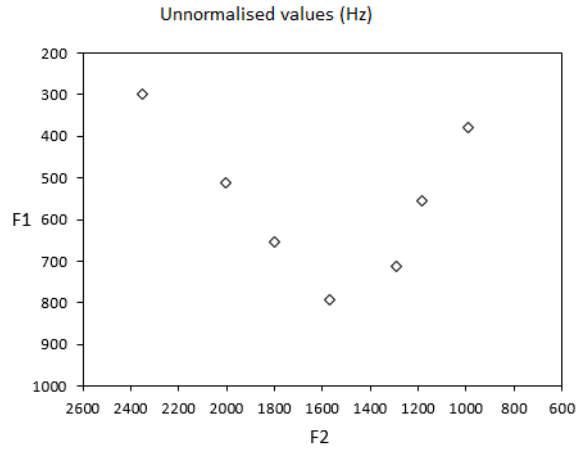


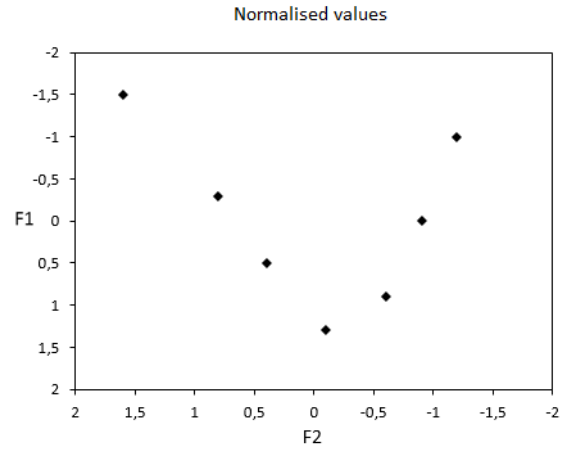
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
61	AG	+	-	-	-	+	-	+	-	+	-	+	-	-



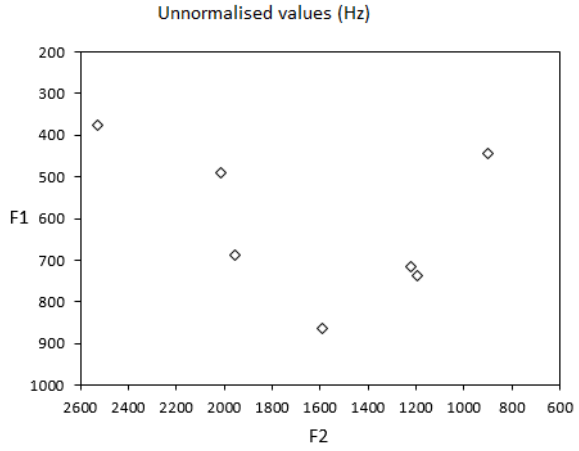


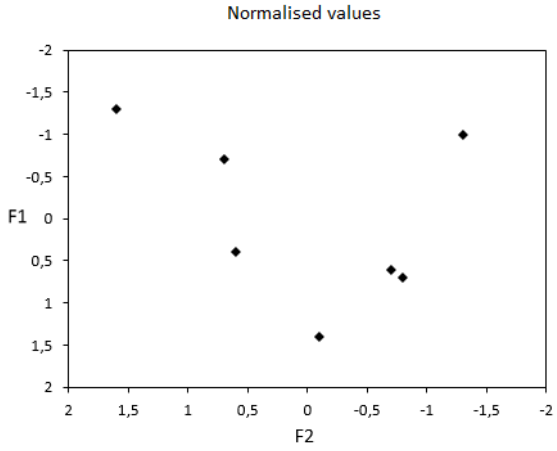
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
62	AZ	+	-	-	-	+	-	-	+	+	-	+	+	+



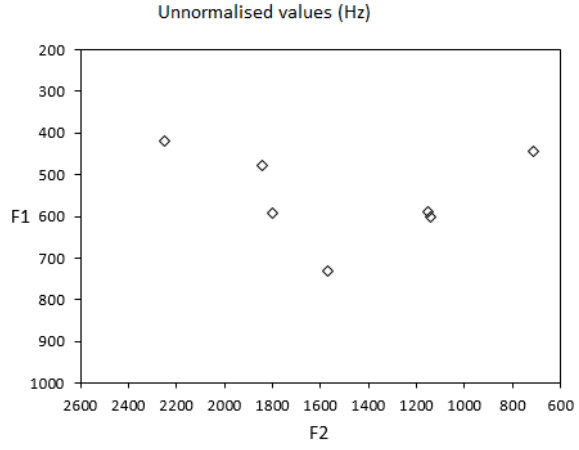


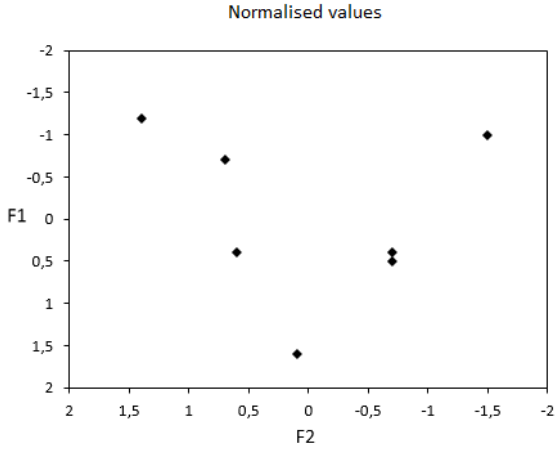
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
63	AM	+	-	-	-	+	-	+	-	+	-	+	+	-



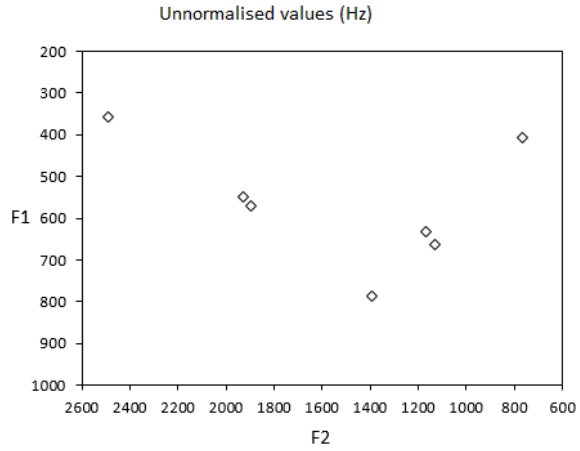


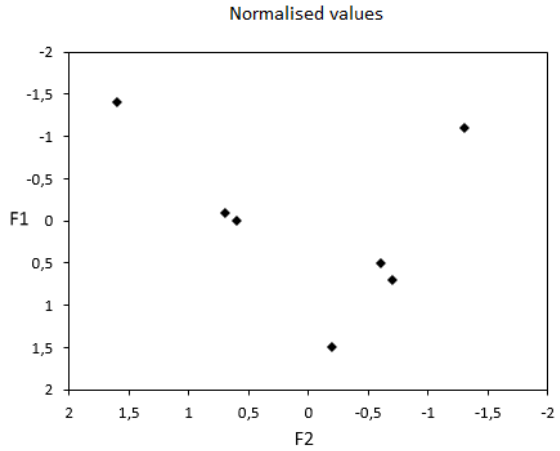
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
64	EG	+	-	-	-	+	+	+	-	-	-	+	+	-



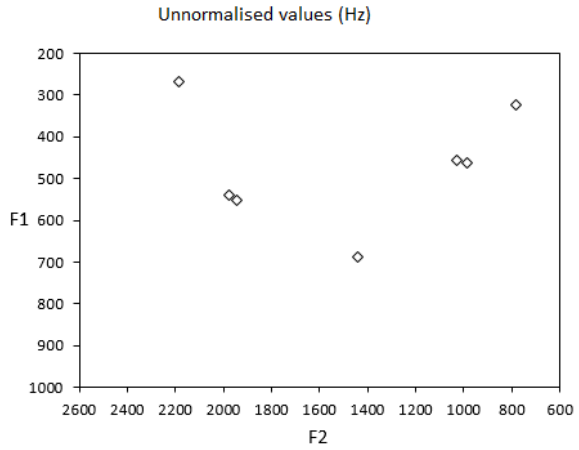


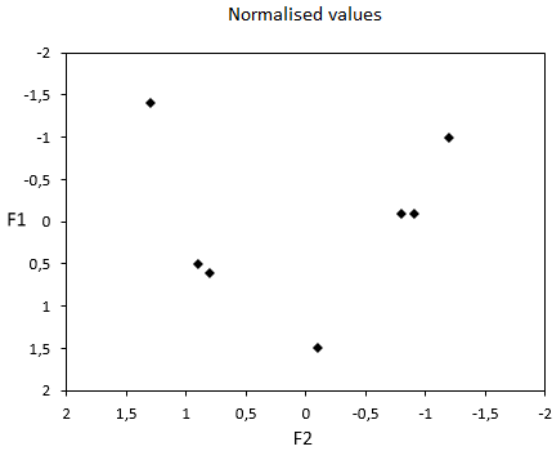
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
65	EB	+	-	-	-	+	-	+	-	+	-	+	-	-



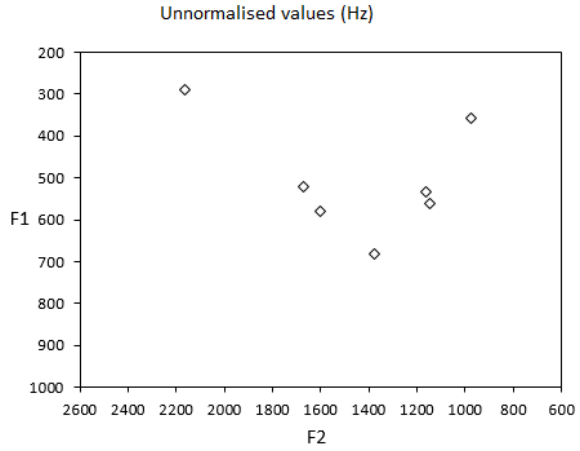


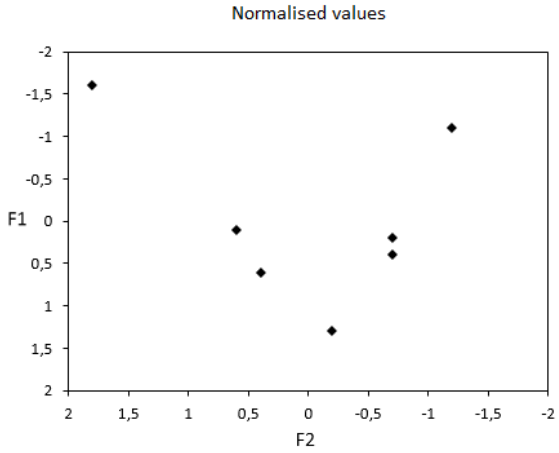
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
66	MCC	+	-	-	-	+	-	+	-	+	-	+	-	-



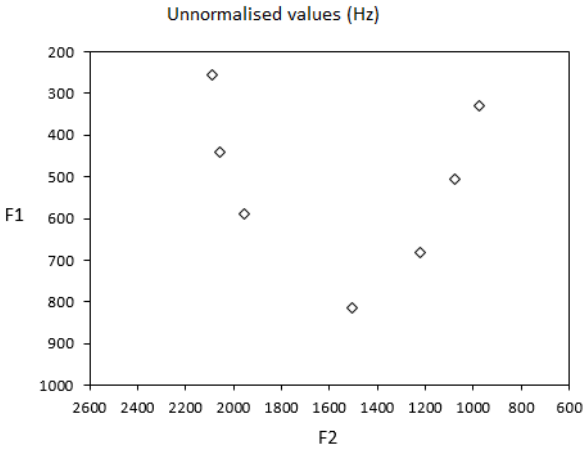


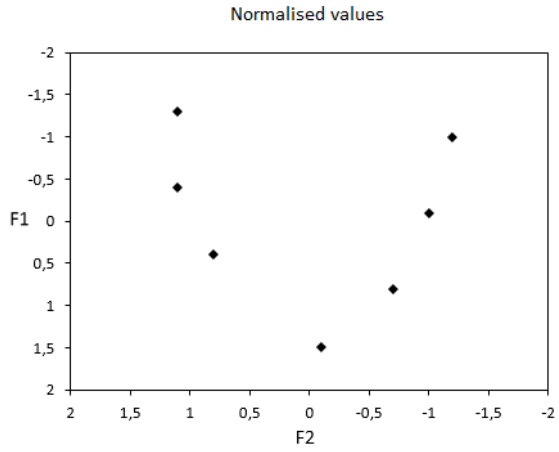
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
67	TB	+	-	-	-	+	-	+	-	+	-	+	+	-



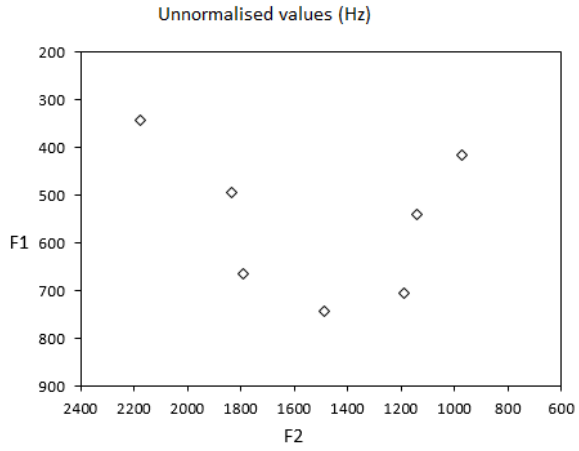


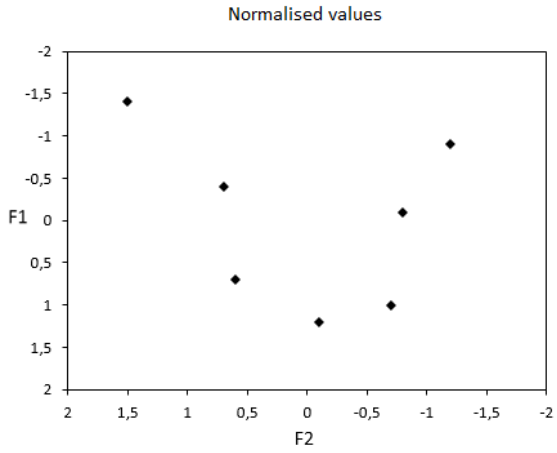
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
68	PT	+	-	-	-	+	-	+	-	+	-	+	+	+



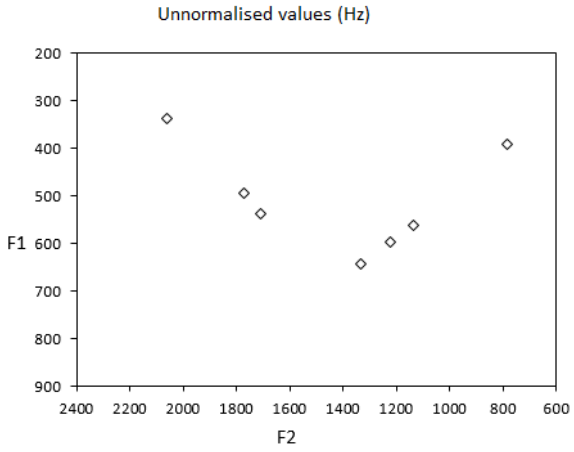


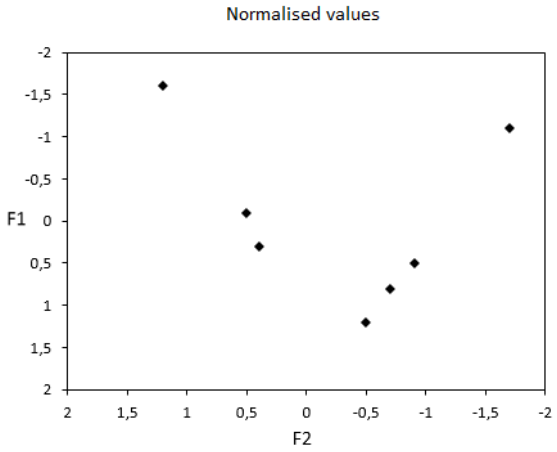
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
69	EP	-	+	-	-	+	-	+	-	+	-	+	+	+





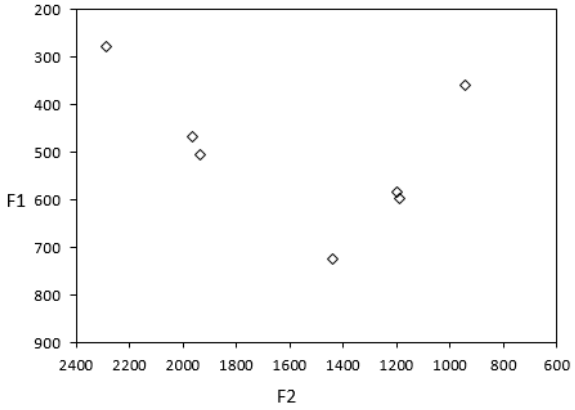
Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
70	AMP	-	+	-	-	+	-	+	-	+	-	+	-	-





Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
71	AMP	-	+	-	-	+	-	+	-	+	-	+	-	-

Unnormalised values (Hz)



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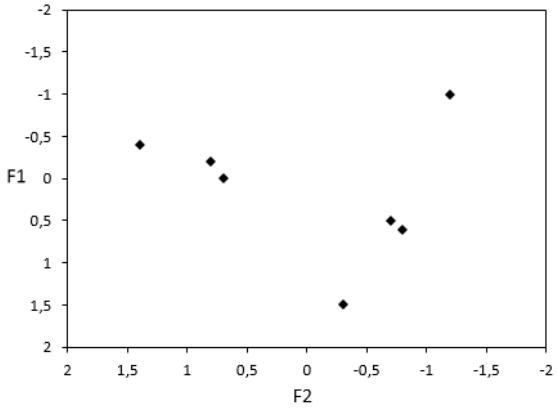
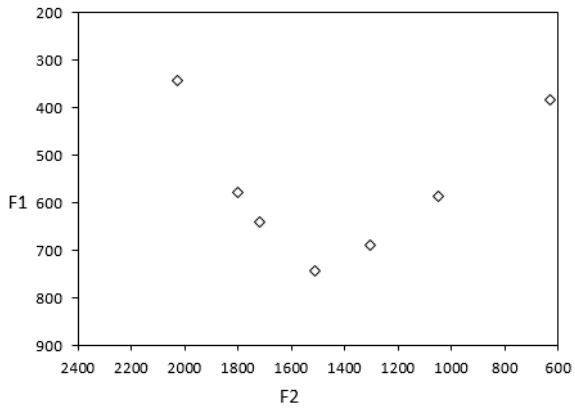
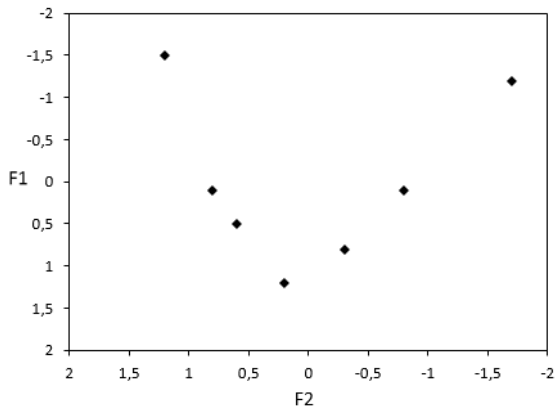


Number	Speaker	Gender		Age grading			L1				Lang dominance		Vowel contrast	
		F	M	15-34 yrs	35-54 yrs	55-75 yrs	CAT ♀	SP ♂	CAT ♂	SP ♀	CAT	SP	/e-ɛ/	/o-ɔ/
72	J	-	+	-	-	+	-	+	-	+	-	+	+	+

Unnormalised values (Hz)



Normalised values



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